DOCUMENT RESUME

ED 331 472 IR 014 953

AUTHOR	Wedemeyer, Dan J., Ed.; Lofstrom, Mark D., Ed.
TITLE	Accessing the Global Network: Weaving Technology and Trade in the Pacific. Proceedings of the Annual Conference of the Pacific Telecommunications Council (13th, Honolulu, Hawaii, January 13-16, 1991).
INSTITUTION	Pacific Telecommunications Council, Honolulu, HI.
PUB DATE	Jan 91
NOTE	913p.; For the proceedings of the 1990 conference, see ED 320 566. Some papers contain light and/or small type and may not reproduce well.
PUB TYPE	Collected Works - Conference Proceedings (021)
EDRS PRICE	MF06/PC37 Plus Postage.
DESCRIPTORS	*Communications Satellites; Delivery Systems; Developing Nations; *Distance Education; Foreign Countries; *Global Approach; Higher Education; Information Management; *Information Networks; International Organizations; International Trade; *Telecommunications
IDENTIFIERS	Broadband Cable Teleservices; Pacific Region

ABSTRACT

The 1991 conference focused on a broad range of issues and impacts and was designed to promote discussion on the ways in which telecommunications are currently used in Pacific rim business and industry. These proceedings contain more than 150 papers presented during sessions addressing the following topics: major issues in world communication, a global approach to communications, information networks in the Pacific rim, Pacific communications satellite proposals and developments, broadband public communication, distance education technology and techniques, computer mediated delivery systems, rural and remote applications of telecommunications, and international telecommunications cooperation. Most of the papers include references. A subject index is provided. (DB)

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Pacific Telecommunications Conference
13th Annual Conference

Proceedings

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PTC '91

January 13–16, 1991
Sheraton Waikiki Hotel, Honolulu, Hawaii

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Accessing the Global Network: Weaving Technology and Trade in the Pacific

Proceedings

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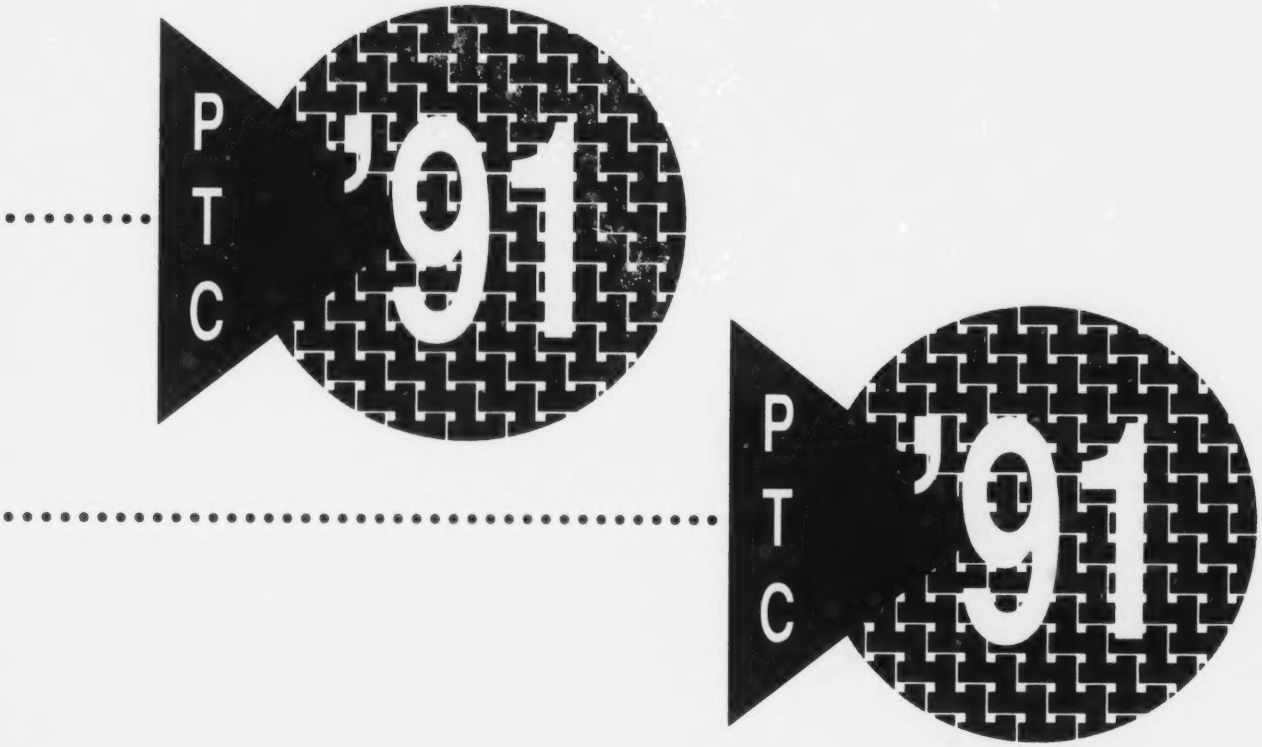

January 13–16, 1991
Sheraton Waikiki Hotel • Honolulu, Hawaii

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Published by
Pacific Telecommunications Council
1110 University Avenue, Suite 308
Honolulu, Hawaii 96826, USA

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THE PACIFIC TELECOMMUNICATIONS COUNCIL

PTC'91 is organized by the Pacific Telecommunications Council, an international non-governmental, non-profit organization. The council is regional in nature, embracing members from all the countries that play a role in the development of Pacific telecommunications. Its 290 members from Industry, Academia and Government are dedicated to promoting the understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere--North, Central, and South America; East, South and Southeast Asia; Australia; New Zealand, Melanesia, Micronesia and Polynesia.

Foreword

This volume represents the largest collection of conference papers yet to be delivered at an annual Pacific Telecommunications Conference. Some 151 contributions are contained herein, representing the participation of more than 315 professionals from nearly 40 countries.

This year's theme, "Accessing the Global Network: Weaving Technology and Trade in the Pacific" focuses on a broad range of issues and impacts. Analysis of the contents indicates that the major categories of interest are (in order of the number of papers in a specific category): Networks; Applications; Business Issues; Satellites; Regulatory Policy; Technical Development; Socio-cultural Impacts; Investment; Economic Development; and, Competition.

Within these categories, a number of sub-categories also gives us a hint of the overall focus of the conference. The sub-categories with the largest number of contributions were: Private Networks; Distance Education; Mobile/wireless; ISDN; Network Management; Video; Data Networks; and, Pacific Island Nations.

This volume, while large, contains an index of the papers. Each paper was summarized and five key words were assigned. By consulting the index one can find a specific paper which addresses a particular topic. The index will refer to a paper number which can be located in the table of contents.

As PTC'91 participants, we can be proud that our thirteenth annual conference will contribute significantly to the Pacific telecommunication database. Over the past twelve years, PTC participants have contributed more than 1500 conference articles. This represents the "lion's share" of the literature written to date on telecommunication in the Pacific region.

PTC'91 carries on the "tradition of excellence" established by previous Pacific Telecommunications Council events. We dedicate this volume to the thousands of contributors over the past twelve years, and in particular, to the hundreds who will participate and learn at PTC'91. A special thanks to the PTC Director, his staff and the student volunteers who have worked so deligently to make this truely a "world class" conference.

Mahalo and Aloha,

Dan J. Wedemeyer
Mark D. Lofstrom
Editors
Honolulu, 1991

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Monday, January 14, 1991

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NOTES

"HEARTPIA GIFU"

ADVANCED INFORMATION SYSTEM, AND REGIONAL DEVELOPMENT

TAKU KAJIWARA

Governor of Gifu Prefecture, JAPAN

ABSTRACT

With the phrase "World Heartpia, Gifu" as a goal, Gifu Prefecture is promoting the application of new technologies in telecommunications and computers in the field of regional development. In this speech, the Governor will introduce how Gifu Prefecture has worked to promote new information technologies in regional development beginning with the Hi-Vision Gallery.

1. HEARTLAND OF JAPAN, GIFU

Gifu Prefecture is situated in the center of the Japanese archipelago. The population center of Japan is seated in the central area of Gifu Prefecture. Gifu is, so to speak, the heartland of Japan. The population of Gifu Prefecture is about 2,100,000. It covers an area of about 11,000 square kilometers, that lies between 0 and 3,000 meters above sea level, 82 percent of which are forests inhabited by various kinds of wildlife.

As Gifu is the point of contact between East and West Japan, both of Japan's eastern and western cultures mix with each other.

It has also served as a stage for a turning point in Japanese history. Gifu is the treasure house of the standard Japanese culture with both eastern and western cultures in harmony.

Consequently, a lot of foreigners who have enjoyed visiting here recently have evaluated Gifu as truly the "Real Japan".

Our total economic output for fiscal 1987 reached 5,194,100,000,000 yen (39,909,000,000 dollars at 130.15 yen per dollar). Gifu is an important center of the aerospace industry in Japan with a background of highly developed modern industries. Gifu is trying to play an important role as a base of highly advanced science and technology as well. A good illustration of this is the recent establishment of the Frontier Science Research Complex of National Institute for Fusion Science, the Micro-Gravity Laboratory of Japan and the Japan Ultra-high Temperature Materials Research Center.

2. ADVANCED INFORMATION BASE, GIFU

Information is most valuable in the information oriented society. The local community needs to be guided by regional management so that new information can add value to commodities, services and people's lives.

The strategy of the local management of Gifu consists of "Exchange, Solidarity and Creativity", which plans to construct a system to create valuable information with people's solidarity and cooperation. I will call information which is transfered by human contact, "hot information" and which is by machine, "cool information". With the development of the computer and telecommunication systems as new media, the local society has recently found less difficulty in gaining cool information.

However, hot information, where freshness is as important as it is to fresh food, is closely connected with the decision-making functions of management in the company.

Therefore, accessibility to hot information is invaluable to facilitate favorable situations for companies and to develop the local society.

Although the main role to create informaton is played by human beings, it is the computer and telecommunications that support it. They assist the human brain and nerves.

Preparing this cool information system is the fields of welfare, industry, and administration is the key to form the base of advanced information in Gifu. The cool information system will make rapid progress serving as both brain and nerve in the local society.

3. THE INFORMATION FARM

The following three information bases will take on importance in the future advanced information-oriented society.

(1) -- INFORMATION FARM --

The "information farm" in the information-oriented society is equivalent to a farm in an agricultural society and the factory in the industrial society. The information farm (IF) produces information regularly and intentionally - a typical example of which is the public or private research center where both hot and cool information systems are combined, fused and information is continually produced. IF includes, needless to say, the government, municipal offices and private companies.

(2) -- INFORMATION MEADOW --

Official information is regularly exchanged unintentionally in both the public assemblies and restaurants. These places can be called information meadows (IM) where the blending of various information gives rise to a new sort of information. It is an important function of the city which produces information not intentionally but regularly.

(3) -- INFORMATION HUNT --

A typical example of an unintentional and irregular information activity is the informal party,

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which is not work but play and held more often at night. Fantastic information can be found unexpectedly. The ground to enjoy hunting information is called the information hunt (IH). IH sometimes acts as a more important role than IM in producing information and is an indispensable function in the city.

4. COOL INFORMATION SYSTEM

The following is an outline of the cool information system which has been promoted in Gifu Prefecture.

(1) HI-VISION SYSTEM

The first Hi-Vision gallery in the world was founded in Gifu Prefectural Art Museum in April 1989. As art collections are stored in software, the visitor can summon favorites merely by pressing a button. Besides software of the existing art collection at the museum, software from the Elmotage Art Gallery has been introduced. And software from the Olsay Art Gallery as well, is also planned to be introduced. This has created a totally new method to appreciate art and added another valuable dimension to the art gallery.
As of Oct. 31, 1990, 752 observers in 84 groups from 28 countries have visited this art gallery. The first mobile Hi-vision system in the world has been completed this year and has gained popularity here. The application of Hi-vision is being examined both by the distribution map center of the Gifu Prefectural Library, and by Sports Science Research Center for research on exercise form. The city of Ogaki has been designated as a Hi-vision city by the Ministry of Posts and Telecommunications. Both the cities of Gifu and Kakamigahara have been designated as Hi-vision communities by the Ministry of International Trade and Industry.
A "High-vision kingdom" will be built by diffusing the Hi-vision systems with on-line equipment throughout the whole prefecture.

(2) LOCAL CAPTAIN SYSTEM

Both the cities of Ogaki and Takayama have introduced multi-direction communication systems called videotex and supply local information. Especially, in Takayama international tourist city, where old streets and traditional culture have remained, videotex dispatches tourist information throughout the whole nation with this system. The city has also installed terminals on streets to give tourist information in both Japanese and English to visitors.

(3) TELETOPIA

We are actively involved in the information-oriented policy promoted by governmental ministries and agencies.

1) Teletopia (Ministry of Posts and Telecommunications)
----- Cities of Ogaki and Takayama

2) New media community (Ministry of International Trade and Industry)
----- City of Gifu

3) Intelligent city (Ministry of Construction)
----- City of Gifu

(4) Construction of administrative information network in Gifu Prefecture

The construction of an administrative information network has been under way to revitalize the administrative system by utilizing information multilaterally and to form the base to send advanced information aiming at starting its operation in April 1991. 414 multifunction terminals will be installed in the Prefectural Office, the Prefecture branch offices and local agencies. A optical fiber LAN will be constructed in the existing buildings of the Prefectural Office and the branch offices.
A network to connect them all through satellite and public circuits and so on will be built. Electronic mail, electronic indicating board and office automation systems for administration including a financial accounting system, are being projected.

(5) SPREAD OF THE URBAN-TYPE CATV (Cable Television)

The urban-type CATV, Cable Communication Nagara River has been preparing to open a station in Gifu City, which has a population of 400,000. CATV is admired for being a very useful media for local society information-oriented at the dawn of the era of versatile utilization of the satellite.

(6) NEW MEDIA FOR WELFARE

Systematization of information can become a useful measure to overcome not only geographical handicaps between areas but also physical and age handicaps among human beings, giving the handicapped equal opportunities and equal participation in the society. With this background, advanced welfare devices have been developed and publicized for the physically handicapped and the needy elderly since 1990.
The concept of the intelligent hospital has been developed in the prefectural hospitals where the hospital information systems, medical support systems and the local medical information system will be introduced in succession beginning in April 1991.

(7) VAN (Value Added Network)

The physical transportation VAN, Seino Information Services, and the local VAN, Future Information Network have been established and information has been exchanged effectively between them.

(8) FIRE-FIGHTING/DISASTER PREVENTION COMMUNICATION NETWORK

The newtork consists of independent lines that link the offices of national level, prefecture, cities, towns and villages in the form of telephone, facsimile and simultaneous transmission system. At present the system is ground-based. A satellite communication system will be added next year.

5. ASSIGNMENT IN THE FUTURE

(1) DEVELOPMENT OF SOFTWARE

Computer software is to be developed. Both national and international software development bases named "Softpia Japan" have been built in Ogaki city. The emphasis is to construct the facility to train people to develop software.

(2) SPREAD OF TERMINAL MEDIA

Terminal media designed with local needs in mind, is being discussed. The fields related to welfare, medicine and education will be stressed. It is looked upon as essential for the development policy for agriculture, forestry and small & medium-sized enterprises, it will also be used for small and underdeveloped towns and villages.

(3) ON-LINE SYSTEM

On-line equipment will be introduced for each information system in the fields of welfare, industry and administration.

(4) INTEGRATION

The integrated system is welfare, industry and administration will be developed and applied by utilizing ISDN and so on.

6. WORLD HEARTPIA (HEART AND UTOPIA), GIFU

The objective is to advance Gifu Prefecture as an "World Contact Plaza" by making full use of its beautiful nature, hot-springs, abundant traditional culture, highly advanced technical bases and so on, which are all directly related to the development of IF, IM and IH. At the same time, friendly exchange of information can be expected with people in the world through both hot and cool information systems by expanding our total information systems throughout the world by means of satellite.
In closing, it is our dream to advance Gifu Prefecture, the center of Japan, the heartland of Japan, as a port to export the hearts of the Japanese people, "World Heartpia, Gifu."

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The Research and Development Work on Information Technologies in Telecommunication Laboratories, Taiwan, R. O. C.

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Abstract

The R & D work on information technologies in Telecommunication Labs has made great progress in recent years, especially on software methodology, large scale software projects, multi-media information system, protocol engineering, artificial intelligence and expert system. The achievements and developments of these areas are to be discussed in five sections respectively.

1. INTRODUCTION

The missions of Telecommunication Laboratories (abbreviated as TL) are (1) to support the advanced technologies required in Directorate General of Telecommunications (DGT), a parent organization of eight subsidiary organizations, (2) to support the local telecommunication industry through technology transfer, and (3) to conduct the basic and applied research in the fields relevant to telecommunication operation. With these missions, the organization of TL is made up of 6 technology research laboratories and a model shop. These 6 technology research laboratories concentrate their research efforts on the areas of network planning, transmission, switching, information, outside plant, and applied research. The model shop converts R & D results to field applicable products.

Due to the advancement of information technologies and the commencement of the computer & communication (C & C) era, the Information Technology Laboratory (abbreviated as ITL) was established in 1985 to conduct various research and development projects that are relevant to the operation of telecommunication organizations. The following selected areas are either having had significant results or having edge-leading importance in the future:

(1) Software Methodology
(2) Large Scale Software Projects
(3) Multi-media Information System
(4) Protocol Engineering
(5) Artificial Intelligence and Expert System

The major accomplishments and/or the future planning work for the above five areas are briefly described in the following sections.

2. SOFTWARE METHODOLOGY

The R & D work for the software methodology started in 1986. A steering committee and a working group were established in DGT consisting of the key personnel and the software engineers respectively from various organizations under DGT to promote software methodology and to hold seminars on the substance of software methodology. After three-year endeavoring efforts, a DGT Software Development Procedural Guide (SDPG) [1] was established and published for trial use by the software developing personnel of various organizations. A total of 18 projects had participated in the trial use and the opinions were reflected back for the amendment. After amendment, the second edition of the DGT SDPG was released for prevailing use. Besides, many kinds of software tools were developed or acquired to accompany the use of SDPG. Among them, a Documentation Tool (DT) was developed for the computerization of document production work. Moreover, a series of training programs were held in the Telecommunication Training Institute to teach how to use the SDPG and the related tools. A work team was created to help the developers solve various problems arising during various software developing stages.

The second result in this area was the establishment of a "DGT Software Acquisition Procedural Guide (SAPG)" [2] and its trial use. This guide established a procedural standard and a communication language between DGT organizations and could be used to monitor the software developing phases.

After careful evaluation of the SDPG and the SAPG, the Ministry of Communications (MOC), the superior organization of DGT, has decided to adopt these two Guides as the standards of MOC. Training programs for the personnels in 21 organizations under MOC have been prepared to promote the use of these two Guides.

The future research efforts for the software methodology will be concentrated on the areas of software reuse, object-oriented programming and software automation.

3. LARGE SCALE SOFTWARE PROJECTS

A large scale software project was being carried out in the ITL to practice the self-developed software methodology. From Jan. 1986, a Telephone Subscribers Service Order Processing System (SOPS) [3] was undergoing its redesigning work to cope with the recent technology. A Chinese and English workstation standard was established for use in many SOPS stations and VAX minicomputer with centralized access of file storage was adopted to be the host computer for each operation center. The system spent 150 man-year finishing its software development work in three years and has more than one million line of code in C (80%) and Fortran (20%), more than 100 files, and more than 100 volumes of system documentation.

The main functions of SOPS include telephone service order application, reception, verification, fee calculation, PABX application processing, line assignment operation, pre-payment operation, appointment date dispatching processing, automatic telephone number assignment, fee payment operation, switching center operation, measurement center operation, operation of outside plant dispatching center, line installation processing, task completion processing, file store processing, service statistics collection and statistical displaying, and business forecasting, etc..

The SOPS system has been on line in Yuan-lin office of Taichung area, including its subsidiary offices, Kaohsiung Metropolitan area, including Fong-Shan, Lin-Yuan and Jiou-Chu-Tang, and Taipei subareas with 3 and 7 prefixes since Aug. 1988, Jan 1989 and Sept. 1989 respectively, with databases containing 130,000, 500,000 and 800,000 subscribers respectively in each operation center. The system is gradually expanding its coverage areas. At the date of writing this final manuscript (nov. 5, 1990), the numbers of subscribers have increased to 180,000, 620,000 and 1,050,000 in Taichung, Kaohsiung and Taipei areas respectively, after the cutover of newly procured 3 VAX 6423 host computers. This system not only established a remarkable milestone for the large scale operation support system developed in TL and used by telecommunication organizations but also obtained a welcoming appraisal from the telephone subscribers for the efficient and accurate service quality. A construction plan for the SOPS was approved by the Executive Yuan to extend the system to the entire island of the country in three years. After the completion of SOPS for the whole island, the telephone service speed and quality should be considerably raised.

Several large scale information systems or operation support systems are been planned in ITL to automate the telecommunication operation, such as Billing Data Collection System, Integration of 12 Major Customer Information Systems, Transmission Operation Support System, Switching Operation Support System, etc.. The accomplishment of these systems in DGT would greatly improve both the operational efficiency and quality of the telecommunication organizations in the R. O. C.

4. MULTI-MEDIA INFORMATION TECHNOLOGIES

Telecommunication services have had the trend of being diversified with information content varying from single medium (voice, data, image or video) to multimedia and telecommunication networks evolving from telephone network and data network to ISDN and even broadband ISDN. Research and development of new customer premise equipments and network technologies are necessary for the provision of integrated multi-media telecommunication services.

In the area of multimedia information technologies, there are two branches of R & D work which have been and are ongoing in ITL. They are the integrated multi-media telecommunication terminals and multi-media value-added services. The former includes: (1) PC-based ISDN terminal with integrated voice, packet data and visual phone capability, (2) Multi-media G4 facsimile terminal with Office Document Architecture processing and image character sending/receiving capability, (3) Computerized communication terminal with the capabilities of videotex, FAX, teletex, MHS, directory services conforming to the CCITT T.65, (4) Multi-media messaging workstations with the capabilities of interactive video, voice, image editing and exchanging through MHS or broadband network. The latter includes MHS, videotex and bulletin with integrated voice, character, FAX and even video messages. In both branches of work, functionality planning, standardized communication protocol and multi-media coding standards and processing technologies are involved.

For the former, PC-based ISDN terminal and mixed-mode G4 facsimile terminal are being developed. For the latter, a G3 fax store and forward [4] system with a framework of MHS is being developed and nearly completed.

5. PROTOCOL ENGINEERING

Protocol engineering, the set of disciplines associated with the rational specification, testing, and maintenance of distributed data communications and computer network systems, is a young and important field; through its practice our modern data communication systems achieve astonishing levels of cost-performance.

The early research of protocol engineering in the project of computer communication and expert system of ITL included specification technology, validation and verification tools, and conformance testing. As for the specification technology, we established and developed the tools for ESTELLE [7] and ASN.1 [8], the world-wide standard proposed by ISO for the specification of communication protocols and data structure descriptions. Some OSI protocols (like ISO 8571 FTAM [9] and ISO DP 10589 IS to IS Dynamic Routing Protocol [5],[10]) have been described in ESTELLE and ASN.1 and semi-automatically implemented from its formal specification using tools. Validation and verification are important in checking the correctness of protocols. We developed the tool based on time transmission grammar to assist the protocol designer in designing communication protocols. To achieve the integrated environment of computer aided protocol engineering, powerful tools (with graphical input of protocols) are planned and designed to perform the validation and verification. When ISO OSI gained the major current in communication world, conformance testing revealed its importance in checking the conformity between different protocol implementations. In view of this fact, we started to study the conformance testing method and methodology, including test specification language TTCN [11]. The tool of prototype compiler for TTCN to translate abstract test cases to executable test cases has been established. It is a significant step to develop generic conformance testing system.

As the conformance testing becomes more and more important, we spend most of our efforts on conformance testing technology and systems. A specific prototype conformance test system performing ISO DP 10589 conformance testing was designed and developed. In the near future, a full set of ISO DP 10589 conformance test system will be finished. On the other hand, a more general conformance test system based on ISO DIS 9646 (Framework and Methodology for Conformance Testing [11]) has been undertaking. We understand that it is not easy to develop such a large software system. Therefore, studying methodology and tools for conformance testing becomes the major issue. It includes a test suites management system, tool for automatic test cases generation, and a test cases execution system. All of these tools are under development. After a two-year project, a complete prototype for generic conformance testing environment will be finished.

6. ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM

Artificial intelligence is greatly emphasized in telecommunications recently. With the application of AI techniques to telecommunications, service quality can be enhanced and operation cost reduced. At present, according to business need and labor requirement, our research on AI techniques in telecommunication is focused on expert system techniques and natural language processing. In expert system techniques, two systems - A Traffic Control Expert System for Network Contingencies [6] and An Expert System for Telephone Exchanges' Maintenance and

Management - are being developed. As to natural language processing, the focus is on discourse analysis and machine translation. The following is a more detailed description of these projects.

(1). A Traffic Control Expert System for Network Contingencies

With the cooperative efforts of Telecommunication Labs. and Long Distance Telecommunication Administration, an experimental prototype, TRACONES (A Traffic Control Expert System for Network Contingencies), has been developed. The system is aimed to facilitate network managers' ridding the long distance network of contingencies and keeping the network in good operation.

A prototype of TRACONES (the part of DC-400M digital coaxial cables) has been developed according to the actual installment of network and the statistics of telecommunication traffic. The work includes the design and construction of a database for all the DC-400M coaxial cables' network structure in Taiwan and the statistics of telecommunication traffic in day time, night time and rush hours, the collection and analysis of expert knowledge for long distance traffic control, the construction and expansion of knowledge bases, and the integration of the various knowledge bases and databases as well. The prototype has now been submitted to field testing in Long Distance Telecommunication Administration since June, 1990.

(2). An Expert System for Telephone Exchanges' Maintenance and Management

With the development of telecommunication techniques, various types of exchanges are being used in Taiwan. But men with specialized techniques are hard to be obtained and the preservation of expert knowledge is not easy; the maintenance and management of these exchanges are therefore quite difficult. Hence, to design an expert system to facilitate the maintenance and management of these exchanges is the most urgent. After related resources are considered, an expert system for GTD-5 exchangers' maintenance and management is chosen to be developed first. Then, with the experience of GTD-5, the system can later be modified and expanded to be used in exchanges of other types.

The system will be developed with the collaborative efforts of North Telecommunication Administration and Telecommunication Labs. The experts in North Telecommunication Administration will offer their knowledge and experience about the maintenance and management of exchanges. And the researchers in TL will be responsible for the analysis of the collected data and knowledge and the development of an expert system for GTD-5 exchanges' maintenance and management.

(3). Natural Language Processing

The research of natural language processing is focused on discourse analysis and machine translation. The aim is to combine text analysis techniques with speech recognition and synthesis techniques to develop a multi-language interpreting telephone system. Before this long-term task is achieved, some middle-term and short-term projects are being processed for technique cultivation and experience accumulation as well as for economic factors. What we are presently engaged in and going to be engaged in are Automatic Telephone Switching System Capable of Talking in Text Form, and Mandarin Utterances with Its Customers and Automatic Telephone Directory System.

7. CONCLUSION

The information laboratory is conducting many projects. Some are of development nature and some are of forward-looking nature. All these projects are focused on one of the following two missions: to serve as a resource to provide expertise on software support to all divisions in TL and DGT, and to introduce new useful technologies to TL and DGT, such as quality assurance, privacy and security protection software factory, software reuse, object-oriented programming, rapid prototyping, expert system, A.I. techniques, and communication software. All the projects are progressing well and have made good achievements during the past five years.

In order to keep up with the trends of new and emerging technologies, the acquisition of the latest information is always carefully heeded. By employing foreign consultants, cooperating with universities and research institutions, and entrusting them with projects, our research standard is enhanced and the inadequacy of information is compensated. It is vital to have sufficient participation in relevant international science and technology activities, such as participation in international conferences, workshops, standards activities, as well as universities and research institutions.

As far as the missions is concerned, some important areas such as establishing quality metrics, quality control process, testing process, software change measurement, code inspection, productivity measure, standards, etc. must also be enhanced. Feedback from users must be solicited for improvement and enhancement. More efforts should also be devoted to promoting of the use of this laboratory's products.

8. REFERENCES

[1] "Directorate General of Telecommunications (DGT) Software Development Procedural Guide (SDPG) "

[2] "Directorate General of Telecommunications (DGT) Software Acquisition Procedural Guide (SAPG) "

[3] J.T. Wang, Y.S. Lee and H.S. Chen "The planning and development of service order processing System.", Telecoms Technical Quarterly, Directorate General of Telecommunications, Taipei Taiwan ,vol.9, no.2, Nov. 1989, pp..1-29.

[4] M.F. Tsai and C.H. Wang "Facimile store and forward communication network", Telecommunication Technical Conference,Directorate General of Telecommunications, Taipei, Taiwan, March 1990 PP. 205-220.

[5] C.S. Lu etc. "Study on a Multi-peer protocol conformance test system", Telecommunication Technical Conference, Directorate General of Telecommunications, Taipei, 1990 PP. 177-203.

[6] C.M. Shiao etc. " A Traffic Control Expert System for Network Contingencies ", Telecommunication Technical Conference,Directorate General of Telecommunications, Taipei, Taiwan, March 1990 PP. 155-176.

[7] ISO 9074, Information Processing System - Open System Interconnection - Estelle (Formal Description Technique based on an Extended State Transition Model).

[8] ISO 8824, Information Processing System - Open System Interconnection - Specification of Abstract Syntax Notation One (ASN.1).

[9] ISO 8571 -1/ -2/ -3/ -4/, Information Processing System - Open System Interconnection - File Transfer Access and Management (FTAM).

[10] ISO/IEC JTC1/SC6/WG2, Intermediate system to Intermediate system Intra-Domain routing exchange protocol for providing the Connectionless-mode Network service (ISO 8473), edited by D. Oran, 15 December, 1989.

[11] ISO/TC97/SC21, OSI conformance testing methodology and framework, ISO DIS 9646, 1989:
    Part 1: General Concepts,
    Part 2: Abstract Test Suite Specification,
    Part 3: Executable Test Derivation,
    Part 4: Requirements on Suppliers and Clients of Test Laboratories,
    Part 5: Test Laboratory Operations.

PRIVATIZING THE NATIONAL TELEPHONE COMPANY -- HOW DO YOU DO IT?

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ABSTRACT

This paper discusses the process and the major decision points for a government seeking to privatize its government-owned telephone system. It reviews the hurdles which must be crossed if a country is committed to telecommunications section liberalization through restructuring of the government-owned telephone company. It highlights preparing the company for sale, soliciting bids, and establishing an effective regulatory regime to oversee the behavior of the new company and its potential competitors. The author draws on his experience as an advisor to The World Bank in the Argentine and Venezuelan restructurings, as well as his experience in advising Hungarian and Czechoslovakian officials in liberalizing their telecommunications sectors.

INTRODUCTION

Telephone privatization is the buzz word of international telecommunications. As countries look for alternatives to inadequate domestic telephone systems operated by governmental agencies, they often look to the private sector for rescue. Privatization of government-owned enterprises has worked well in many industries traditionally operated by the private sector and subject to normal competitive forces. But telephony is different. Privately owned telephone companies offering local exchange services are still the exception. And effective competition for basic local telephone service remains a hope for the future, not the present.

Encouraged by The World Bank and other international multilateral financing agencies, countries are examining private ownership of local telephone systems as a potential solution to a host of deficiencies in present government- run operations. A range of alternatives has developed. All fall within the generic concept of "restructuring" but only a few can be properly called "privatization." The alternatives range from the government's hiring private individuals as consultants and contract managers, to sharing profits with a foreign telephone company to manage the system, to selling part ownership of the company to raise capital, to selling controlling interest and management responsibility for the company to a foreign operator while retaining partial ownership for the benefit of employees and other domestic interests.

The author leaves to a separate paper a discussion of the merits and demerits of these various "restructuring" alternatives. His purpose here is more limited: to discuss the process a country must pursue to address and execute a full scale "privatization" of the domestic local exchange telephone company.

THE DECISION TO RESTRUCTURE AND PRIVATIZE

The typical country seriously considering privatization will display a set of common characteristics. The government-owned telephone company will have generally poor operating characteristics in the form of unresponsive service, under-capitalized investment, and an inefficient work force. Its pricing structure for services will be badly distorted by political considerations to favor certain users, equipment manufacturers and/or labor groups. Normally, the central economic planners will have identified the underdevelopment of the telecommunications sector as a major drag on general economic development. And the business community and local subscribers will be expressing high levels of frustration with the inadequate service.

Privatization will move through a series of phases. But first comes the fundamental policy decision of abandoning the status quo for a better alternative. Not every alternative is better. It must hold the prospect of better serving several important and simultaneous goals. The country has a right to expect the following benefits from restructuring:

a. maintaining and improving the quality of customer service;

b. expanding the availability of the types and geographical reach of services;

c. maintaining reasonable prices to consumers;

d. maintaining and expanding the asset value of the company.

Often these benefits will be expressed as goals to be achieved through specific strategies:

a. creating better management incentives for the company;

b. removing day-to-day operations from the national political process;

c. accelerating innovation and capital investment in the telecommunications network;

d. reducing financial demands on the national budget;

e. seeking competitive entry to force the telephone company to improve its economic efficiency.

Many countries have decided that some or all of these goals can be achieved through a restructuring that is less comprehensive than complete privatization. Any analysis must look at the problems as well as the benefits of complete privatization. Privatization is a complex and laborious process. It entails the sale of one of the largest business enterprises in the country. And, by itself, it provides no assurances of improved service. Since local exchange service will likely remain a de facto monopoly, regardless of the terms of the license given the private operator, the country must create a system of incentives to induce the desired behavior from the private monopolist. In other words, the country has to market and sell for fair value an enormous business enterprise. In addition, it must create a system of licenses, regulations, and contractual obligations to ensure the new owners do better than the status quo. This is complex. Any it requires careful thought, planning and commitment of adequate resources. It also requires taking the time to do it right.

CRUCIAL ORGANIZATION AND DECISION ELEMENTS NECESSARY FOR SUCCESSFUL PRIVATIZATION

Several crucial organization and decision elements are necessary for successful privatization. First, the effort has to be tightly structured, and led by a credible and politically secure leader of national stature. Sale of a national telephone company is a very complex political problem, and progressive decisions are impossible unless a person of integrity and stature makes the tough decisions with the full support of the executive branch.

Second, there are difficult decisions as to the scope of monopoly and competition after the privatization. The typical country has significant problems associated with inadequate capitalization and an undeveloped basic wire network. The policy dilemma is how to get high quality business-oriented services up and operating quickly, relying on the forces of competition, while leaving enough of the core business available to the new telephone company to be able to generate the capital to expand and develop the entire network. In other words, a bright line between monopoly and competitive services is not self-evident.

Third, the process requires adequate time to allow the potential buyers of the telephone system to complete a thorough due diligence and to accumulate as much information on the telephone system as possible. At the same time, the events must move promptly to generate and maintain the necessary political momentum.

Fourth, there has to be recognition that telephone privatization is entirely different than other privatizations because a significant part of the telecommunications sector will remain a monopoly service, regardless of the government's desire to expand market competition forces. This requires a balance between introducing competition and creating effective regulatory oversight of the remaining monopoly portions of the marketplace. Regulation will be new and untested in the country which may well have additional problems training regulatory personnel and sustaining the goodwill of the government toward the private enterprise.

And finally, the sale value of the telephone company as an asset will be its potential to generate future cash flows. Less regulation and no competition promise higher cash flows and a higher telephone company value. This is offset by the need to truly protect consumers and to improve the quality of service through guaranteed levels of investment and service improvements. Also the country selling the company needs to protect itself from residual liabilities associated with the transfer of the assets. That is, the sale has to be structured as an "as is" sale with the buyer looking to future profits, not existing in place assets as the value of the transaction.

OUTLINE OF MAJOR ACTIONS REQUIRED TO IMPLEMENT A TELEPHONE PRIVATIZATION

The following outline details the steps in any privatization. The attached Figure 1 illustrates the parallel nature and typical timing of these steps.

I. Phase 1: Get Organized.

   A. Assemble a centrally managed, strong team of experts functioning under the leadership of the central executive with a clear political mandate for change.

   B. Find the substantial financial resources needed to conduct the necessary analysis, evaluation, and execution.

   C. Establish a reasonable time line for completion of the project (see Figure 1), balancing the need for fast action to capitalize on popular and political support against the need for detailed and thoughtful analysis to ensure proper valuation and implementation of the restructuring.

II. Phase 2: Define the Specific Goals for Restructuring.

   A. Define the specific national goals for the telecommunications sector.

      1. What services will be offered in competition and what services will be offered in monopoly?

      2. What service growth and service obligations are reasonable to impose on the new company?

      3. How much capital investment will be required in the new company?

      4. What form and amount of regulatory oversight is appropriate after the restructuring?

   B. Define what exactly is being offered for sale. Is the sale only part of the existing assets of the company, the entire company, or only a license to compete with the existing company? This will require substantial work to inventory the relevant assets and liabilities:

Typical Telecommunications Sector Restructuring Plan

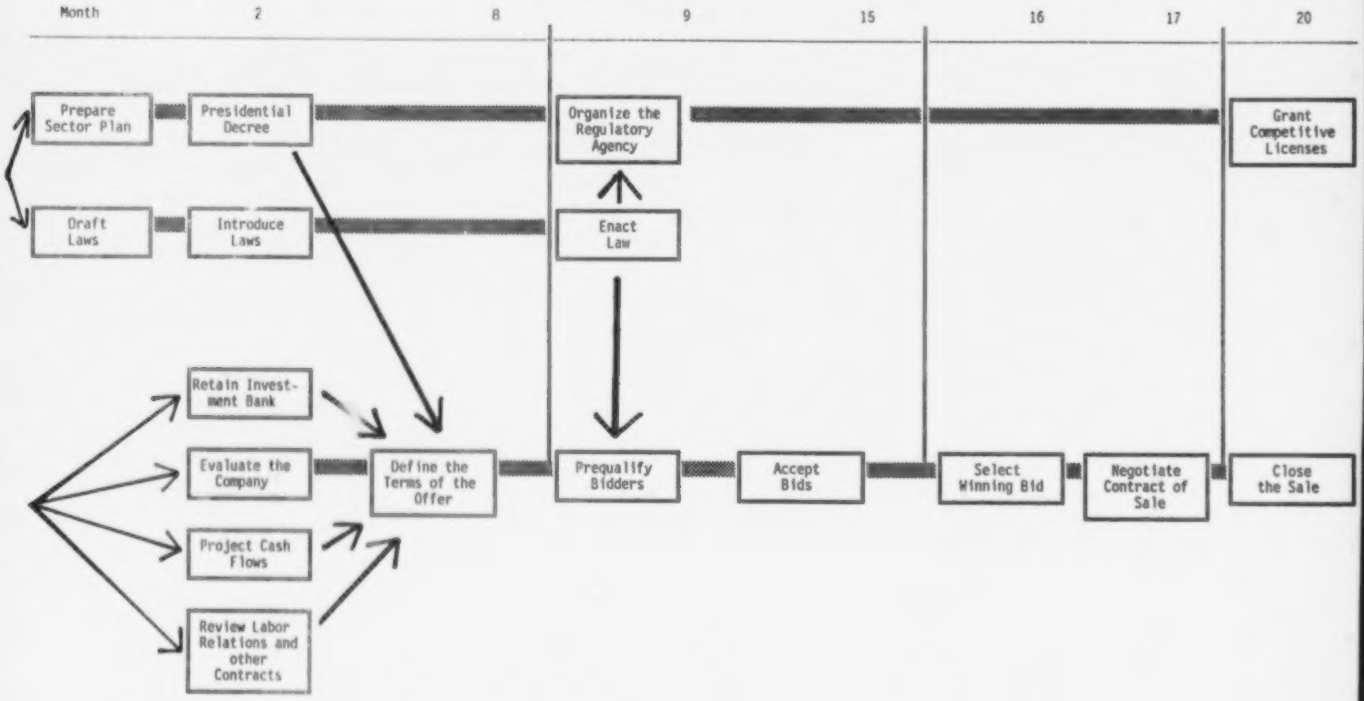
Month
2
8
9
15
16
17
20
Prepare Sector Plan
Presidential Decree
Organize the Regulatory Agency
Grant Competitive Licenses
Draft Laws
Introduce Laws
Enact Law
Retain Investment Bank
Evaluate the Company
Project Cash Flows
Review Labor Relations and other Contracts
Define the Terms of the Offer
Prequalify Bidders
Accept Bids
Select Winning Bid
Negotiate Contract of Sale
Close the Sale

Figure 1

1. Assets -- physical and financial assets;
2. Operating rights -- service obligations/rights to serve/period of the license/geographical scope of service;
3. Liabilities
    a. General debt obligations
    b. Claims of vendors
    c. Labor contracts
    d. Retirement obligations.

C. Estimate the value of the company and set minimum price/terms. This estimate must be based on predicted future cash flows, considering:

1. The scope of the monopoly versus the potential for competitive entry;
2. The liabilities to be transferred;
3. Future capital investment requirements to be imposed;
4. The potential regulatory restrictions on cash flows.

D. Develop the proposed Offering of Sale and Terms of the Bid. This may be one or several documents. It must detail the rights and obligations to be conveyed. It should detail the relevant content of intended statutes which will impose the terms of the operating license, operating requirements and proposed scope of regulatory oversight. It should specify the criteria that will be used to evaluate the competing bids. For example, is it to be a price-only bid? Or is it "price plus"? There can be multiple criteria used, such as service prices, performance prices, and promises to capitalize the system. Remember a significant performance bond will ensure good faith and willing buyers.

III. Phase 3: Seek Out the Potential Bidders and Prepare the Company for Sale.

The company has to be marketed to potential bidders, usually through an investment banker or other sales agent contacting the potential foreign investors. The bid process must provide adequate time for interested bidders to conduct a reasonable "due diligence" investigation of the company, the potential market opportunity, and the country's commitment to real reform.

Similarly, the country needs a chance to perform a "due diligence" on the potential bidders. This requires a system for prequalifying serious bidders.

Simultaneously, the country needs to prepare the company for sale in a multitude of ways. If properly executed, the following tasks will greatly enhance the sales value of the company, and minimize labor force anxiety and potential service disruptions:

1. Change the national laws to permit the sale.

2. Change the domestic content requirements for telecommunications equipment and inter-carrier contracts as desired.

3. Negotiate new labor and debt-holder contracts.

4. Reorganize the company and its personnel to reflect the structure contained in the sale offering.

5. Reprice or retariff services, to the extent anticipated by the offering of sale.

The actual evaluation of the bids received and the selection of the winner should be relatively simple, provided precise criteria are specified in the offer of sale. If the evaluation criteria are ambiguous, the country will face a difficult and politically contentious decision point.

If possible, a second "back-up" buyer should be selected as well to protect the country from "take-it-or-leave-it" negotiating pressure from the successful first choice bidder.

IV. Phase 4: Negotiate the precise Terms of Sale with the successful bidder.

The successful bidder will inevitably seek to revisit earlier decisions the country has made concerning the scope of the operating license, the precise assets and liabilities that will transfer, and the powers of the new regulatory agency. Also, many economic, operational, and technical facts may have changed in the months between the initial offering and the final selection. All of these factors require a final, detailed contract of sale to be negotiated specifying the precise obligations of the buyer and the seller to bring the sale to completion on the designated date of closing.

The country may promulgate a revised regulatory decree/statute to embody the regulatory principles promised in the offer of sale as amended by the negotiations. Also, the country will finalize the terms of the operating license to be awarded. And the parties must assemble the documentation and related schedules such as lists of assets and liabilities necessary for closing the sale.

One area of particular importance in the final contract of sale will be the enumeration of potential contingencies which might develop between the time of the acceptance of the bid and the closing of the sale. Some examples include the following.

1. What are the obligations of the buyer if the deal fails to close?

2. What are the obligations of the government if it fails to deliver the assets as promised?

3. What contingency plans are in place in the event labor or economic disruptions change the basic premises of the parties to the sale?

V. Phase 5: Prepare and execute the closing.

Set up the governmental structure for oversight of the restructured company. Set up the company structure as required to execute the sale. For example, create the corporate entity and the stock for the transfer, etc. And close the sale.

VI. Phase 6: Implement the transition to *private ownership* and operation and new governmental oversight and regulation of the sector.

Set up/organize/train the regulatory agency and its personnel. Promulgate the regulations and procedures for the regulatory body. Supervise the new company as it develops the bookkeeping and record keeping necessary to generate the information required for regulation. Set up the regulatory processes for:

1. Issuing new licenses to new entrants;

2. Conducting performance evaluations of the licensees;

3. Ordering and implementing further changes in the telecommunications structure.

CONCLUSION

The process of privatization is complex. It contains all the complicated legal, financial and operational issues present in any multi-million dollar corporate sale of assets. In addition it requires dramatic political action by the national government to confront the problems woven through government ownership of the telephone system. And finally, it requires progressive government policy making to set up an expert, independent regulatory structure to oversee the newly privatized (but still monopoly) telephone company. This paper has presented the decision and action points on the path to privatization. It has not attempted to describe the arguments for and against various policy decisions. But in defining the hurdle points for decision, it is evident that effective privatization requires careful planning, excellent staff work, extensive evaluations, and tough negotiations.

THE ROLE OF TELECOMMUNICATIONS IN TRADE IN SERVICES IN THE PACIFIC RIM DURING THE 1990S

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1. ABSTRACT

This paper examines the telecommunications infrastructure and its implication for trade in services in the Pacific Rim. We discuss the recent effort of achieving the common denominator for trade in telecommunications services and highlight some of conflicting interests. Some policy suggestions are drawn for the future work.

2. INTRODUCTION

We are witnessing the emerging rapprochement of computer and communication. "C & C" has become one of the catchwords of this era. The far-reaching repercussion of this exciting technological advance has been felt in various venues. The observation that jargons such as 'natural monopoly', 'universal service', 'regulation', which were used to describe the telecommunications scene,are increasingly juxtaposed with those such as'privatization', 'custom- tailored service', 'competition' dramatizes the changing reality caused by "C & C." However, technology itself alone did not bring about this change. As expressed quite often, technology is value-free. It can be used in many possible ways. People decide its ultimate usage. That is, technological change is to provide user a more high quality paper. It is she who should paint on this new material.

The latest impact of this technological advance and actions by economic agents has been found in the discovery of the concept of "trade in telecommunications service." This revolutionary idea has just been testing in Uruguay Round under the auspices of GATT. This paper will examine this concept in the context of the Pacific Rim for the coming years till year 2000.

3. TELECOMMUNICATIONS INFRASTRUCTURE AND ECONOMIC GROWTH

Traditional view of telecommunications service as one of social infrastructures had its companion piece of view: there are other at least equally important infrastructures. By definition, infrastructure is a common input needed for overall economic activites. When you have more than two possible choices and your resource is limited, you run into the optimal resource allocation problem. One approach to solve this problem is cost-benefit analysis. You assign the prority of building up several infrastructures according to their calculated net benefit.

When the technology was evolving in a stable manner, the establishment of unversal service was the utmost policy goal of most nations. Compared with highway and electricity, telecommunications infrastructure was paid little attention. The advent of computer technology and its ever increasing application into communications field, however, heralded the dawn of a brave new world. The ever expanding new telecommunications services, whatever it may be called, fundamentally changed the way how the economic activity is organized and found the uncharted area of new economic activity. Telecommunications' backward and forward linkeage effect on national economy has made it a critical strategic sector.

What does this mean in the operational terms? First, the less developed countries began to accord high priority to the construction of their telecommunications infrastructure.
Second, building telecommunications infrastructure can be a core of leap-frogging growth strategy for countries still in the process of transforming agricutural society to industrialized society.
Third, the industrialized economies require the cost effective telecommunications services to sustain their economic growth.

4. TRADE IN TELECOMMUNICATIONS SERVICES

Competitively-priced and newly developed telecommunications services revolutionized the perception that most services, except tourism and transport, were produced and consumed locally. The combined effect of digitization and the phenomenal increase in carrying capacity of modern telecommunications introduces services into the exchange economy at least on par with goods.
Can you think of the multinational corporation without the efficient use of telecommunication services? Companies are using electronic communications to allocate inventory among scattered branches, to manage cash, to link research centers, to transmit and develop designs, to monitor remote installations and for hundreds of tasks aimed at securing competitive edge. The international competitiveness of financial service, banking service, tourism, transport service, professional service, to name a few, increasingly hinges on the efficient use of intermediate telecommunications inputs. The same is increasingly true of manufacturing sector. This is why telecommunications services are called as the "underlying transport mode" for the provision of services.

5. THE COMMON DENOMINATOR FOR TRADE IN TELECOMMUNICATIONS SERVICES

Because of this critical connection for trade in services,we are engaged in the multilateral effort to establish the general discipline for access to and use of telecommunications infrastructure. Telecommunications annex will be the product of such an effort. Even at this moment, the details of telecommunications annex are not settled. Nevertheless, two major principles have emerged throughout a series of working group meetings.
First, the common denominator is to ensure that the general obligations and disciplines of the Framework Agreement (GATS) and the implementation of specific commitments with respect to market access and national treatment provided for in Parties' Schedules are not nullified or impaired by measures affecting access to and use of telecommunication infrastructure (defined to be public telecommunications transport networks and services).
Second, the common denominator should not result in liberalization in any sector without a negotiated commitment having been made in Parties' Schedules. That is, de facto liberalization through this telecommunications annex should be avoided.

To meet the above mentioned objectives, service providers must have access to and use of telecommunications infrastructure on transparent, reasonable and non-discriminatory terms and conditions. The question is, then, the degree of specificity of these terms and conditions. Discussions on this matter plainly reflect different national approaches and manifest conflict of interests among players.

6. POLITICAL ECONOMY OF CONFLICTING INTERESTS

We live in the world of increasing interdependence. We are more accustomed to the word of "globalization" instead of "internationalization." The historical data show that this is actually taking place in the Pacific Rim. A major bottleneck to sustain this pattern is a lack of telecommunications infrastructure. I mean telecommunications infrastructure in terms of physical reality as well as the rule of game.

Telecommunications annex, if there is any, would write the rule of game. Nevertheless, it would not be complete by any means, since every trading country does not have a fairly homogeneous degree of economic development. The following checklist is a summary record of issues requiring further considerations as identified in telecommunications working group in Uruguay Round GNS(1) :

- the extent to which the disciplines set by the common denominator should be applied, that is, are basic telecommunications service providers operating in a competitive environment subject to the obligations of annex?;

- whether the transparency provision should apply to procedures for the establishment of standards;

- the need to retain a provision relating to pricing;

- the scope of intracorporate communication; if this is not defined clearly, then it may lead to de facto liberalization of reserved telecommunications service (2);

- the need to include a provision on anti-competitive behavior by monopoly and exclusive service providers, as well as by private operators.

The coming years of the 1990s will provide a number of international fora where these issues are properly taken and resolved. The process of filling in the details of the common denominator would inevitably reveal manifolds of conflicting interests. We can identify at least four as below. First, conflict between the developed countries trying to fulfill the demand of multinational corporations and the developing countries whose policy priority is in the universal service. Second, conflict between the public network operator wishing to protect the reserved services and the value-added service providers who would like to exploit private leased circuits to the maximum extent possible with no strings attached. Third, conflict between ITU, which is specialized in the technical issues of telecommunications and more concerned about the protection of telecommunications infrastructure, and GATT more inclined toward trade implication of telecommuncations services. Fourth, conflict between telecommunication sector per se which is supposed to behave myopically and other executive branches of government which takes into account the overall balance in the trade negotiating posture.

7. CHALLENGE OF THE 1990S FOR THE PACIFIC RIM

The Pacific region consists of numerous islands and continental land masses scattered around and across the world's largest ocean. For this reason, economies in the region are separated by much larger distances than in case in the Atlantic region. The Pacific Rim is also a region of extreme political, economic, cultural diversity. Because of this, the electronic highway in the Pacific Rim has haunted policymakers, businessmen, scholars. Some have preached prophetically the splendid harvest from such a masterful work, while some have vehemently opposed to it by arguing it would just help to aggravate the existing gap between the developed and the developing countries. This brings the emotional issue of how to distribute the enlarged pie from such a project 'fairly'? If we can tackle this old question in the new environment seriously, if we can shed a fresh light on this question, then the construction and successful operation of the Pacific electronic highway would serve as a great equalizer.

It is no longer secret that most policy makers are impatient. They want to see the good outcomes as early as possible, or at least before the next election. The heavy investment in telecommunications infrastructure poses a dilemma for them. There are two more related problems. First, concerns arising from scarce foreign exchange. Second, competition for funding with basic human needs such as health, sanitation, or education. Nevertheless, as discussed in section 3, time has changed; it is a high noon for telecommunications infrastructure investment. And the case is the most compelling in the Pacific Rim than anywhere else.

8. LIVE AND LET LIVE

There is one thing certain. Discretionary regulatory policy will be a ultimate stumbling block for the sustained growth of trade in telecommunications services. We can make this case in many ways. To put most fundamentally, discretionary regulation simply cannot catch up with the rapidly changing technology and market reality. Just because of political power attached to the discretionary regulatory body, those involved would be extremely hesitant to confess the above fact. The best policy is to set the minimum level of guideline which would establish a level playing field and enhance the predictability of business environment for players.

The recent Uruguay Round has been our first step into the virgin territory of trade in telecommunications services. If we do not learn from our experience and cannot share, our time and energy devoted to derive the common denominator for the global elctronic highway would be just a waste. The unilateral extortion of advanced countries' policy to the less developed countries would not serve to establish a common denominator acceptable to many trading countries. And, threat by the powerful countries to turn to specific reciprocity of bilateralism might be self-defeating in the long-run. Every country should try to eschew the disastrous fragmented globalization. In the global village, we should live and let live. For this final destination, you can make a difference.

9. REFERENCES

(1) "Report of the Chairman" Working Group on Telecommunications Services, MTN.GNS, October, 1990.

(2) Choi, Byung-Il "Optimal Regulatory Response to Trade in Telecommunications Services" Korean Journal of Information Society, Volume 2, Fall, 1990.

TELEPORTS AS CATALYSTS FOR INTERNATIONAL TRADE

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1. Abstract

This paper discuses developing country access to the rapidly expanding global information services market. Government support of information processing industry is examined, with a focus on the role of dedicated information processing zones. Consideration is given to the importance of forming development policy that builds national advantage in high-growth industries.

2. Development Models: Lessons and Pitfalls

One of few advantages to being a latecomer in today's international export markets is the freedom to focus national resources without threatening existing industries -- the freedom to support entrants in high-growth industries. In pursuit of this advantage Asia's emerging economic powers look to the experiences of the region's NIC's for models and lessons. And with good reason: The rapid industrialization of natural resource poor countries like Japan, Singapore, Hong Kong, South Korea and Taiwan offer the world's most powerful models of export-driven growth.

In constructing development policy patterned after these growth models, attention must be paid to pitfalls as well as to successes. Chief among these pitfalls is the inability to upgrade into more stable markets -- markets where advantage is built on factors other than continued reliance on low cost labor. Asia's newly industrialized dragons are all struggling to make this transition -- struggling to promote structural change without slowing growth. Mounting competition for lowest-cost exporter positions makes the transition all the more critical.

Successful development policy provides support and direction for entrants in industries with the greatest potential for differentiation and sustained growth. If one lesson can be taken from the Japanese development experience it is that of targeting high-growth export industries. The strength of Japan's postwar industrial policy has been in providing direction to industries which hold strong potential for both succeeding in export markets and supporting the development of related industries.

Unfortunately, while much can be gained from analyzing the development policies of Japan and the region's NIC's, successful entry and growth in today's export markets will involve new choices, new obstacles. Industrial policy-makers in emerging economic powers must anticipate structural change in today's global economy and determine:

- Which industries hold the highest potential for long-term success in export markets?
- How should potential entrants in these industries be encouraged and supported?
- Which groups of industries are likely to reveal synergistic relationships?
- What role can foreign firms play in preparing domestic entrants for competition in export markets?

3. The Globalization of Information Service Markets

Although it is clear that international trade in services represents the fastest-growing, most important segment of the global economy, statistical analysis beyond this level is fraught with difficulties. Data on the service sector's contribution to Gross Domestic Product (GDP) and employment is especially scarce. Satatistical shortcomings are caused largely by categorizing and tracking difficulties, and in most instances statistical analysis understates the role of services.

International Monetary Fund (IMF) statistics on the volume of global trade in services show a tenfold increase between 1970 and 1987. The export of services from developing countries has been estimated at one-quarter of this $500 billion 1987 worldwide service trade market.

Among the service trade industries, information services markets are growing most rapidly, but quantitative data on the volume and growth of these services is also scant. A report to the United Nations Conference on Trade and Development has estimated that in 1985 the global market for software and information processing services was $55 billion. The report projected growth to $163 billion in 1991 and $341 billion in 1996.

Driven by explosive growth in the software and data conversion industries, information service markets have globalized and developed to the point where they present a major impetus for structural change. Advances in the economics and technology of electronics and telecommunications have created vast new global markets for information services.

Although a number developing countries, notably India, Brazil, South Korea, the Philippines, Mexico and Taiwan have competed in global information processing markets for many years, the past five years have widened developing country access to these markets dramatically. Technological change is knocking down entry barriers and creating new markets for the export of rapid turnaround services.

The experience of Saztech International Inc. is illustrative of this structural change. Saztech International of Kansas City, Missouri is a data conversion firm which has used offshore subcontractors for the past seventeen years. Saztech subcontracts much of its work to its affiliate Saztech Philippines Inc, a data processing firm in the Philippines, in which Saztech International holds a minority share.

Until two years ago Saztech bulk shipped hard-copy data to Manila, where it was keyed onto disk or microfilm and shipped back -- resulting in a two week turnaround.

Two years ago long-distance transmission costs had fallen to the point where Saztech decided it could meet the demand for faster turnaround services by shipping data electronically. The company now ships data to Manila via trans-Pacific fiber optic cable, where it is processed and retransmitted often in the same day. In what represents the next step in this transition, Saztech has invested in image processing equipment which allows documents to be scanned on the customer's premises reducing turnaround times even further.

Saztech's long-distance service is handled by MCI which until recently held an equity share in Philcom, one of the Philippine's record carriers. Saztech Philippines Inc. receives tax credit and relaxed import duty incentives from the Philippine government.

The globalization of information services markets is bringing enormous opportunity to developing countries. Entrants in these industries have the potential to claim sustainable positions in high-growth world export markets. Effective and immediate government support for these entrants will spur national economic competitiveness.

4. Teleports as Entry Platforms

The Indian information industry provides one example of government response to this technology-driven market transition. India has long been a center for offshore information processing and software design. Indian design firms maintain affiliations with a number of large Western and Japanese information technology leaders, including AT&T, Texas Instruments, Unisys, Digital, and Data General.

With the exception of Texas Instruments, which maintains a satellite link between India and its London office, data is shipped or transported electronically via leased lines. A planned venture between the Massachusetts Office of International Trade and the Indian Ministry of Science and Technology promises to provide a more cost-effective, more flexible solution.

The proposed India Teleport project would provide dedicated satellite uplinks in Boston and Pune to facilitate trade between Boston's computer conglomerates and software design houses in India. The teleport facilities would support smaller-scale entrants in both countries and create new markets for rapid turnaround information services.

The Teleport project is still in the planning stage, pending approval from the Indian government. Approval is likely, however, as the Indian government is eager to encourage further growth in its information industries which are reportedly growing at 40 percent annually. Significant obstacles to this growth exist in India's trade relationship with the U.S. government and its reputation for neglecting intellectual property protection.

The India Teleport project points to an important lesson -- dedicated international telecommunications facilities are an indispensable platform for accessing information processing export markets. Without this platform, processing firms must rely either on links provided by clients or on existing international facilities. Neither option is cost-effective for small-scale entrants or for firms targeting multi-client markets.

5. The Jamaican Model

A teleport in Jamaica has allowed firms in that country to lead a burgeoning information industry in the Caribbean Basin. Information industries in Puerto Rico, Jamaica, the Dominican Republic, and the Barbados have all expanded rapidly over the past five years by capitalizing on the U.S. market. The Jamaican government has provided the greatest degree of support to information processing industry.

Jamaica Digiport International (JDI) was formed as a three-way joint venture between AT&T, Cable & Wireless (West Indies) and Telecommunications of Jamaica (ToJ), with ownership shares divided 35:35:30 among the respective partners. C&W's overall share in the venture was expanded through a November 1990 restructuring of ToJ in which C&W increased its share in the carrier to 79 percent. The remaining shares are held by private investors.

JDI's first venture, the international teleport at the Montego Bay free zone was inaugurated in December 1988. The Montego Bay facility maintains international links with the U.S., Canada and the U.K. via leased Intelsat circuits and a Standard "A" ground station. JDI will pick up additional international circuits on the TCS-1 submarine fiber optic link to Puerto Rico and the mainland U.S.

JDI provides switched and dedicated international lines via an AT&T 5ESS switch. Switched service for voice, data or video is available at rates up to 56 Kbps, while dedicated lines can carry up to 1.5 Mbps. JDI is prepared to provide higher capacity service offerings as demand dictates.

In addition to selling high-quality international links from Montego Bay, JDI offers digital connectivity from the capital city Kingston. Initial investment from the three principals totalled $8.5 million.

To accompany JDI's technical platform for the export of information processing services, the government has structured a powerful financial package. The Port Authority and the Jamaican government offer the same incentives and benefits to information service firms as to manufacturers, including relaxed import duties, permission to operate foreign currency accounts, and tax exemption on profits.

Although JDI is licensed to provide telecom services in all of Jamaica's Free Zones, the group has limited operations to the Montego Bay zone for the medium-term. Early growth was weak after the facility suffered extensive damage from the 1988 hurricane. Growth in the interim has been strong and should continue as legislation is underway to extend the incentives package to firms which link up from Kingston. The Jamaican government estimates the Digiport will have added over $200 million to the country's GNP over its first four years of operation.

A variety of information processing firms -- wholly Jamaican-held and joint ventures -- have leased circuits and office space in the Digiport. Many firms have formed relationships with information service brokers in the U.S. For example, one Montego Bay-based firm Bay Telemarketing Agency Ltd. recently formed an affiliation with Saztech International, the multinational data conversion firm discussed above.

The enormous range of services offered by these entrants can be seen in Exhibit 1.

Several points can be drawn from the successful development of the information processing industry in Jamaica.

- Rapid development of information industry depends on the provision of appropriate inputs. Existing firms and new entrants are locating in Montego Bay to access the dedicated high-quality international links, an economic incentives package, affordable industrial office space and number of other advantages.

- The involvement of foreign players brings improved access to resources. AT&T and C&W have brought capital financing, technical expertise, high-profile exposure, and enormous marketing capabilities to the Digiport project. AT&T helps the Jamaican government market the Digiport in the U.S.

- Collocating information processing centers and established manufacturing zones captures important economies of scale. Manufacturers in the zone gain from improved international connectivity and from abundant information processing services. Information processing firms gain from domestic sales to manufacturers.

6. Asian Opportunities

The Jamaican model holds great potential for the Asia-Pacific region. The declining costs and increased capacity of the region's international telecommunications links have removed barriers to trade with service importers in the United States, Japan and Western Europe. Japanese information technology firms, in particular, import an enormous quantity of software services.

The region's explosive economic growth is resulting in improved access to both funding and technology.

Exhibit 1
Montego Bay Service Offerings

- Data conversion
- Image processing-scanning
- Database research/creation
- Typesetting
- Mapping and surveying- computer support
- Proofreading
- Desk-top publishing
- Programming
- Financial services
- Inventory services
- Electronic mail
- "800" number services
- Microfilm/microfiche conversion
- Insurance claim processing
- Software design
- Telemarketing
- List processing
- Data capture/processing
- Airline ticket data processing
- Credit card data processing
- Engineering specifications processing
- Medical databases
- Legal databases
- Telephone directories
- Payroll services
- Rebate processing

Source: AT&T

A number of the firms in the region's NIC's have already established substantial export capabilities in information services, notably those from South Korea, and Taiwan. However, the most pressing call for action is to the developing countries of the region -- those most free to anticipate and act upon structural change.

While every developing country in the region could benefit from increased support for information service industry, some stand out as particularly well-positioned to accelerate industry growth through teleports:

India

- High concentration of trained engineers - widespread English fluency
- Established software design industry - Bangalore
- Existing financial incentives package for software exporters
- Related electronics industries - telecommunications equipment and computers
- Increasing trade ties with Western Europe
- Labor cost advantage

China

- Common written language and trade ties with potential client nations - Taiwan and Hong Kong
- Well-established Special Economic Zones (SEZ's) particularly Xiamen and Shenzhen.
- Labor cost advantage

Philippines

- Liberalized telecom sector
- Developing software design industry
- Trade ties with the United States
- Labor cost advantage

Thailand

- Growing commitment to high-tech zones and teleports--Lam Chabang and Mab Taput
- Openness to BOT funding approach
- Supporting industries--consumer electronics
- Strong trading position among the ASEAN nations
- Labor cost advantage

7. Obstacles

Among the obstacles to the establishment of information processing zones financing looms largest. The region's capital-starved PTT's often face difficulties mobilizing funds to extend even basic service to enormous sectors of the population. Political opposition to allowing foreign competitors into the lucrative niche telecom markets is often enormous.

Build-Operate-Transfer (BOT) strategies present one option for circumventing financing and management difficulties. Although not always a politically saleable alternative, BOT concessions can accelerate project implementation and the transfer of management and technical knowhow. Most importantly, foreign carriers provide access to a powerful international marketing infrastructure.

The establishment of dedicated international telecom facilities can be commercially threatening to the existing international carrier. There is, however, potential for structuring a beneficial relationship in which the existing carrier would gain from increased capacity and spillover business. In Jamaica, for example, Jamintel leases international capacity on the JDI earth station but also leases circuits to JDI for access to the TCS-1 cable. In another scenario, the carrier might benefit more directly by participating in the teleport venture.

In structuring the regulatory framework for information processing industry, governments confront a number of complex legal obstacles. The protection of intellectual property is a critical prerequisite to attracting foreign information trade, particularly in markets driven by proprietary design like computer software. Organizers of the India Teleport noted that piracy concerns have dampened support for the project among some Boston-based information technology firms.

Another area of regulatory concern, excessive restrictions or taxes on the transborder data flow are an obstacle to developing trade in information services.

There is much that remains to be done at the international level to facilitate developing country trade in information services. Upcoming negotiations in the GATT talks will attempt to hammer out a final agreement on services trade. While a discussion of the potential implications of these negotiations is outside the scope of this paper, it is clear that a widely supported agreement will be a crucial step in further developing the global information services trade.

9. Conclusion: Capitalizing on Information Services Markets

Developing sustainable export capabilities in today's information-intensive global economy requires new strategies, new policy models. Information services account for the most rapidly expanding share of world export markets and developing countries that effectively support entrants in these markets can prompt growth with significant implications for every sector of their economies.

Growth in information services industry facilitates and compliments rapid development in other important service industries particularly, finance, tourism, and transportation. There are also important linkages to export manufacturing industry as discussed above. Most importantly, however, information industries accelerate the development of the human resources and domestic capabilities that fuel sustainable growth.

Developing countries require a comprehensive strategy to effectively capitalize on expanding information services markets. State-of-the-art international telecom facilities, packaged with incentives at least on par with those extended to the export manufacturing sector, can provide the platform for national advantage.

Challenges for Trade in Telecommunications: Conflict and Compromise between the United States and Japan

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1. INTRODUCTION

Four decades ago, the United States had a virtual hegemony in the international economy and the global trading system. It was not only the world's manufacturing and agricultural center but also the dominant leader in innovation, science, and technology. Over the last four decades, the world has turned into a multipolar system, and emerging countries of the Pacific have become important to the international trading system based on the flows of information. Among them, Japan is challenging the economic and technological superiority of the United States and threatening its productivity base, as well as its shares in the global market.

In the vibrant Pacific region, Japan plays a prominent part in setting the patterns of telecommunications usage and in the introduction of intelligent systems. Japan's GNP is now reaching $4 trillion, which is twice that of West Germany. It is home to eight of the world's ten largest public companies and boasts seven of the world's largest banks. Added to Japan's economic prowess is the fast pace of development of Asia's NIEs (Newly Industrialized Economies), which are emulating Japan in setting up nontariff barriers against imports of telecommunications equipment on the plea of incompatibility of standards. The ASEAN countries constitute the most critical marketplace in the trade future of both Japan and the United States. The ASEAN countries represent America's seventh largest trading partner, even as America represents their second largest after Japan.

With this new dynamic emerging in the Pacific region, competition between the United States and Japan intensifies, causing greater trade friction between the two countries. Historically speaking, there is no precedent for the current U.S.-Japan conflict. Japan has always remained in the orbit of the Western world in international relations. With nationalistic pressures growing on both sides, the greatest challenge for the leaders of both countries is to combine their strengths in economic terms and in the pursuit of democratic values. Emmott (1989) points out that high savings and skillful approaches to production, trade, and finance have enabled Japan to achieve impressive economic success. On the other hand, the U.S. savings-investment gap is being filled by the rest of the world. A great deal of misapprehension and dissension have emerged on both sides without concrete changes toward improved relations in telecommunications trade or market penetration.

The global market for telecommunication equipment and services in 1989 exceeded $400 billion, but deregulation and strict rules against expansion of the Bell Regional Operating Companies (RBOCS) is impeding the global reach of the U.S. industry. An interconnected global market with corporate mergers tends to reduce the impact of balance-of-payments issues in trade. Global mergers circumvent competition, help to retain a share of the market, and diffuse protectionist trade measures. For example, in 1989 Japan's trade surplus declined by 17 percent, but the calculation may be misleading. This is because Japan's oil imports increased, weakening the yen, and the surplus was calculated at 122 yen per dollar instead of 145 yen per dollar, as was the case in 1988. The telecommunications component of this surplus emerges from exports to the United States, which still supplies less than 10 percent of the Japanese chip market. This happens despite the bilateral agreement on semiconductors negotiated in 1986.

This paper will first examine in section 2 the background of trade theory, exchange-rate fluctuations, and nontariff barriers that impinge upon telecommunications trade. This section will also cover the impact of mergers within the telecommunications sector. Section 3 will examine the race for technical superiority between the two countries in telephony, semiconductors, computers, and satellites. This leads us to the current Uruguay Round of trade talks being held at the GATT, which will be dealt with in section 4. The paper ends with an analysis of U.S. and Japan trade relations and concludes that free-trade policies in telecommunications are the most appropriate. Already Emmott (1989) has predicted that Japan will not continue to be as different as we anticipate from other cultures because it is affected by human nature and market forces like other countries. Can this prediction be substantiated by current and future trends?

2. TRADE ISSUES IN TELECOMMUNICATIONS

Since goods and services related to information are among the most dynamic sectors of the trade between Japan and the United states, restrictions affect trade relations. Flows of data accompanying trade are important as well as services because they deal with information about markets, commercial information, product description, technical data, and information about the general framework of trade and monetary policies of the trading partners (Jussawalla, Snow, and Braunstein 1988).

As a consequence of the merger of telecommunications and computers, two hitherto separate industries, banking and telecommunications systems have become interlinked. Nonbanking financial intermediaries are also taking advantage of telematics in providing new services. The electronic integration of financial markets has created greater competition in this part of the services sector. Since deregulation was implemented in both countries, costs of telecommunications services have declined and the mix of products and pricing policies of banks have changed. Electronic trading in banking services has broken down geographic segmentation of markets in the financial services sector.

As the import penetration ratio (proportion of imports to domestic supplies) rises in the Pacific region, services and equipment supplied by any one country will no longer prevail. Supplies now flow into the Pacific region not just from Japan and the United States but from Korea, Taiwan, Singapore, and other countries. A direct spinoff from faster communication links is the creation of new and diverse forms of wealth. This new economic dynamism in trade has led to an increase in Japan's import penetration ratio from 5 percent in 1988 to a predicted increase of 10 percent in 1995 (*The Economist*, December 17, 1988).

The trade gap between the two economic superpowers continues to remain at $50 billion. In November 1989, an unprecedented round of trade talks commenced between trade officials of the two countries. They were aimed at addressing the root causes of the trade imbalance. The mounting political anxiety over trade relations with Japan threatens to restrict U.S. flexibility in dealing with the GATT round of trade talks. Simultaneously demands for protectionists measures are mounting in the United States. In the annual pas de deux that takes place between Japan and the United States, the well-orchestrated response from Japan is to unveil its "Buy American" plan for 1990. MITI is launching a round of initiatives aimed at speeding imports from America. This is being done by offering importers tax breaks and incentives. However, past attempts—such as Prime Minister Nakasone's "Import Now Program"—turned out to be failures. Japan's growing share of the trade deficit is not expected to decline appreciably in the near future (see figure 1). So far, the United States has eliminated its trade deficit with Europe and reduced it with other countries, so that the Japanese surplus continues to baffle the U.S. Congress. This also generates criticism from revisionists in the United States.

In early April 1990, the two countries faced deadlines on at least a dozen trade agreements. An interim report on deep-rooted structural barriers to American imports such as Japan's distribution system and high prices was submitted to both governments. As part of the Structural Impediments Initiative, satellites and semiconductors as well as supercomputers figure in a large way and have become crucial components of the trade conflict between the two countries. MITI hopes through its plan to offer one billion dollars worth of tax credits to companies that boost imports of manufactures from the United States by at least 10 percent. It is also earmarking $1.5 billion in loans to importers and $1.5 million for a data bank that will link foreign exporters with Japanese importers. Tariffs will also end for 1,000 items this year. All these measures should reduce the trade conflict between the two countries to an appreciable extent, depending on the response of Japanese companies. Some action in these regards would strengthen the hands of U.S. negotiators in penetrating foreign markets. The International Monetary Fund in its *World Economic Outlook* for 1990 has called attention to the macroeconomic imbalances in the U.S. economy and suggests that any attempts to deal with it through trade policies would be ineffective. Countries are also apprehensive of the unilateral action which the U.S. Trade Representative is taking through its Super 301 to stem unfair trade practices because that goes against the GATT code for multilateral negotiations. Concern in Washington grows as Japan accounts for 40 percent of the U.S. trade deficit.

As far back as 1985, American trade policy vis-a-vis Japan set its sights on the goal of reducing Japan's savings rate in order to close the bilateral trade gap. According to the Economic Planning Agency of Japan, the average Japanese household saved 15.1 percent of its income in 1987 (*Japan Times*, November 1, 1989). In 1989 household savings aggregated 10 million yen. In contrast, the U.S. savings rate for the same year was 6.6 percent. The Maekawa Commission in 1987 recommended that Japan do away with its incentives for savings such as tax exemptions. Accordingly, Japan abolished the *maruya* tax-free status of savings. But this did not end the trade friction between the two countries (see figure 2 for comparative savings). Japan's latest export promotion plan subsidized by MITI may help to reduce the trade gap if the large exporting and trading houses play by the rules. But as indicated above, if the Japanese plan fails to change either the rate of savings or the total Japanese investment, it will not change the trade surplus it now enjoys. This trend applies not only to the United States but to other trading partners of Japan because it now controls one-tenth of the world's total trade.

The trade frictions that Japan continues to encounter with the United States and the European Community are complex, but they mostly amount to an unwillingness on the part of Western suppliers to treat Japan on a par with other well-established suppliers in the global marketplace (Wilson 1989). In addition, protectionist policies tend to be ineffective when they are imposed without industrial restructuring. When a trade dispute is solved bilaterally, GATT does not have any say if the agreement is broken by one party. Both countries will have to solve the problem through multilateral talks at GATT. Techno-rivalry is at the heart of the dispute. The American argument is that the Japanese have enjoyed the benefits of late-comer transfer of technology from the United States. But technological reciprocity is not allowed because Japanese R&D is done in corporations that are outside government control. This aspect of techno-nationalism surfaced when the NEC corporation of Japan was not permitted to participate in the U.S. government-supported consortium (Sematech) for manufacturing semiconductors.

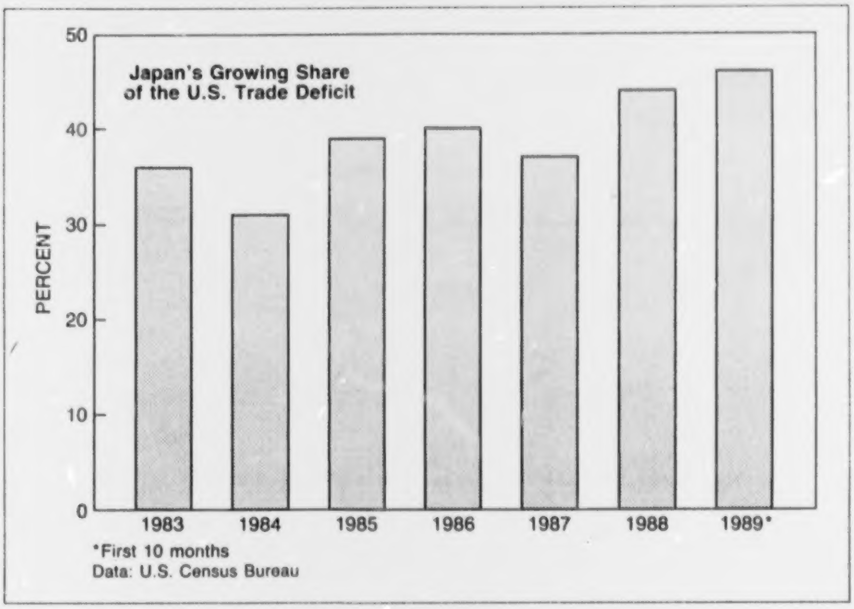


FIGURE 1

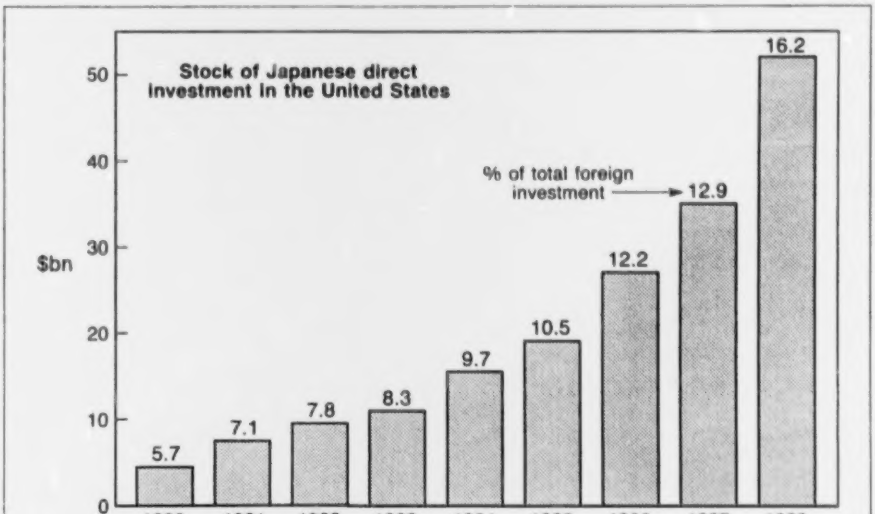


FIGURE 2

On the other hand, NTT will begin competing with U.S. companies that provide data communications to Japanese companies doing business in the United States. In Japan, NTT buys the equipment and leases it to customers, unlike the U.S. system, where customers buy whatever equipment they choose. The control of the free market discriminates against foreign suppliers.

As world services trade grows from its current level of $1 trillion, the United States wants it regulated through the GATT despite the frequent opposition from Europe and the developing countries. On the other side, U.S. investments overseas are almost going unnoticed. Direct foreign investment by the United States rose by $25 billion in 1988 to $351 billion, while foreign investors in the same

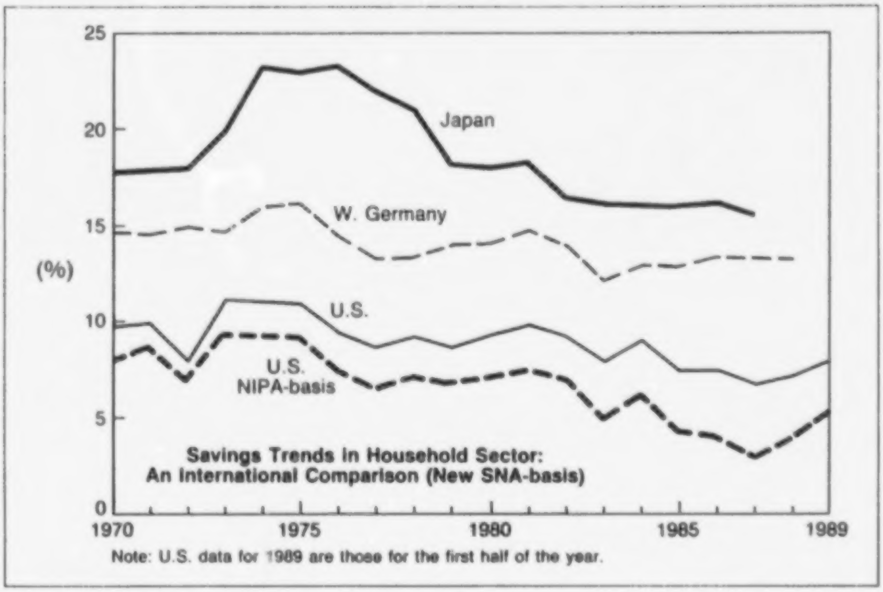


FIGURE 3

year increased their holdings in the United States by $22 billion to $350 billion. This can be attributed to the globalization of markets as a consequence of new information technology. The lower cost of labor is not such an important factor for overseas investment as it was in the past. The impetus is to secure foreign markets, and this has led to 220 American companies working on plans to establish projects overseas. But the scope for investing in Japan seems to be less than the prospect of investing in Europe. Even so, many American companies are earning good profits from their Japanese investments, as shown in figure 3.

Economic forces, regulatory changes, and foreign pressures are creating a more favorable climate for mergers and acquisitions in the United States, but hostile takeovers in Japan will not be possible. Japanese firms in the telecommunications sector are merging with foreign firms as a part of the restructuring of corporate assets. According to Nomura Research Institute, there were 438 mergers in 1988, of which 270 were foreign acquisitions by Japanese firms. Current rules in Japan require mergers to go through domestic security houses, but the SII talks may induce changes in those rules.

Cross-border alliances have become popular as competition in the telecommunications markets becomes more aggressive. It is a low-risk method for cracking global markets. AT&T wants to sell a broad range of chips and make headway in the semiconductor industry, but it does not have a large array of chips. So in 1990 it struck a deal with NEC Corporation under which it will trade its CAD (computer-aided design) chips for NEC's advanced logic chips. Likewise Texas Instruments announced a plan to merge with Kobe Steal to make logic semiconductors in Japan. Motorola and Toshiba, Texas Instruments and Hitachi are other mergers for the semiconductors market. It is a worldwide trend and seems pronounced in the telecommunications industry. Another merger between AT&T and Mitsubishi has been announced for memory chips technology and the sale of semiconductors. Ten years ago the leading edge of the semiconductor industry was with the United States, but through the 1980s that leadership moved to Japan especially for state of the art memory chips. Even Siemens, West Germany's electronic giant, played student to Toshiba in order to produce the one megabit memory chip and then produced its own next generation semiconductor.

The benefits for the American corporation differ in each alliance. They range from licenses to Japanese technology and involvement in Japanese production of memory chips to exposure to Japanese manufacturing techniques. This spate of joint ventures raises questions about American trade policy under which the United States is pushing for a larger share of the Japanese chip market.

The fact remains that despite these mergers helping to reduce trade tensions, Japanese corporations steadily aim at expanding their share of the global market and compete as aggressively with domestic firms as with foreign rivals. The relationship between Japan and the United States is intricate. Japan bought $13.7 billion of U.S. properties in 1989 and has moved into being the biggest investor in the United States in 1990. But the United States does well in Japanese markets. Also Weyerhaeuser exports $1 billion of wood and paper products to Japan each year. Dow sells $600 million worth of chemicals. The largest fleet of Boeing 747s belongs to Japan Airlines. We tend to forget that when AT&T was a monopoly until 1984 it bought equipment only from its own subsidiary, Western Electric.

Table 1
Major Alliances in the Semiconductor Industry

U.S. Company	Japanese Company	Year
Texas Instruments	Kobe Steel	1990
AT&T	NEC	1990
Advanced Micro	Sony	1990
AT&T	Mitsubishi	1990
Intel	NMBS	1990
Texas Instruments	Hitachi	1988
Motorola	Toshiba	1986

Source: *Wall Street Journal*, March 20, 1990

3. TECHNOLOGICAL RIVALRY AND ITS IMPLICATIONS FOR TRADE FRICTION

There is a big gap in the U.S.-Japan Trade Statistics for telephone equipment and in the corresponding market-share figures. Japan Economic Institute Report No. 6A, dated February 10, 1989, describes the slow entry of Japanese manufacturers in the U.S. markets for telephone switches and large business systems because there are entrenched suppliers like AT&T and Northern Telecom Inc. The Japanese are also losing ground to their Korean and Taiwanese rivals for small office systems. The deregulation of Japan's telecommunications industry and the realignment of the yen-dollar exchange rate are helping U.S. equipment makers enlarge their relatively minor share of the Japanese market (see tables 7a and 7b for Japan's exports and imports of telephone terminal and switching equipment).

Throughout the 1960s and 1970s, microelectronic technology has progressed through integration and miniaturization, making the product cycle for electronic output shorter. The increase of circuit density in DRAMs (dynamic random access memory) made the industry move from small-scale integration to VLSI (very-large-scale integration). The industry gained tremendously from a decline in the cost per function of 30 percent for every doubling of chips produced. Prices were being set at below average cost. The interaction between the learning curve and economies of scale encouraged U.S. companies to build their market share and increase production. In the 1970s, the Japanese were still struggling to build a competitive semiconductor industry. By the 1980s, they had carved out a sizable section of the U.S. and global markets. Japanese penetration was based on competitive pricing, keeping domestic prices higher than export prices. They were also exporting higher quality semiconductors with lower failure rates than their American rivals.

Competition intensified over the 64K DRAM semiconductor, which had an inelastic demand because of its many applications. A shortfall in U.S. supplies enabled the Japanese to capture the 64K DRAM market by as much as 70 percent by 1981. By 1983 both U.S. and Japanese firms invested heavily in the 256K DRAM chips, for which demand had taken off. As producers profited from the learning curve, prices declined and American producers began to target Japanese markets by 1984. By the close of 1985, there was a marked overcapacity in semiconductor memory chips and prices plunged worldwide. The Semiconductor Association of America appealed for protection against Japanese dumping in U.S. markets, under section 301 of the U.S. Trade Act. MITI responded with a rebuttal against charges of unfair trade practices. The semiconductor agreement of 1986 promised to give a 12 percent share of the Japanese market to the U.S. suppliers, and Japan promised to stop dumping below-cost chips on third countries, but the agreement did not work out as anticipated.

In 1989 RISC chips (Reduced Instruction Set Computing) started to set speed records and came to be regarded as the basis of a revolution in computer technology. Sun Microsystems of the United States led the way, and it is estimated that by 1993, some 61 percent of all workstations around the world will be based on RISC. Every Japanese computer supplier is also adopting the same technology (see table 9 for the top ten chip producers).

The problem with the U.S. semiconductor industry has been that insufficient investment has been made in research, plant, and equipment. In turn, this made the entire electronic industry in America dependent on foreign supplies. The manufacturing equipment for semiconductors is also in trouble in the United States. One of the few major companies left in the business is Perkin-Elmer, and it is being bought by Nikon of Japan. Likewise, in many areas of computer hardware, U.S. technology is losing out. Table 2 shows the drop in U.S. share of world markets.

Despite the downward trend of technology development in the United States, IBM announced in February 1990 that it has built the first 16-megabit chip, and this high-capacity DRAM will provide the key element in develop-

Table 2
Percentage share of world markets

Product	1978	1988
Hard disks	84	75
Floppy disks	66	4
DRAMS	72.8	16.9
ASICs (customized chips)	90	53

Source: *Fortune Magazine*, January 1, 1990

ing faster and more powerful computers. IBM is thereby maintaining its technological edge over Japan. IBM was also the first to manufacture the 1-megabit and 4-megabit chips. It has licensed its 4-megabit technology to Micron Technology Inc. and to Sematech for the commercial market. Meanwhile, Intel Corporation has set up a joint venture with Mineba of Japan, pointing the way to global mobile business. Likewise, SGS Thomson set up a joint venture with Oki, Texas Instruments with Hitachi, and Motorola with Toshiba. This growth of joint ventures makes "Japan-bashing" out of date. Challenges to the hegemony of Japan's biggest chipmakers are also coming from South Korean companies. Samsung, Lucky Star, and Hyundai have been expanding capacity and sales.

As computing and communications converge through digital networks and as microprocessors automate everything from telephones to toasters, Japanese corporations are planning to get a better edge over their American and European competitors. This is what Nippon Electric Co. (NEC) is doing to AT&T and IBM. BY 1989, NEC had grown to become the world's largest seller of chips, fifth in communications equipment, and fourth in computers. Even so, NEC's sales for 1989 of $21.3 million were only a third of IBM's and half of AT&T's. It was Koji Kobayashi, the emeritus chairman of NEC, who coined the term "C&C" (computing and communications), under which telephones and computers will be married to make instantaneous language translations. This has become the new technology of integrated services digital networks toward which phone companies around the world are racing. By 1995, Japan will buy an annual supply of $5.5 billion worth of computers and telephones for ISDN. NEC is targeting this demand with its vertical corporate integration with IBM. It is in the supercomputers field that this resilience shows up to a greater extent. With an investment of $800 million, Cray Research is running short of resources. It is the only surviving maker of American supercomputers. Cray's Japanese rivals are aiming for its market. National security concerns in the United States are colliding with national competitiveness over the definition of the term *supercomputer*, and it is argued that Japanese manufacturers are selling computers of that type even though they may not be as fast or have the same peak performance. With the global market estimated at $2 billion for 1990, technology in supercomputers is racing ahead of regulatory control. On the one side, COCOM used to deny the export of critical technology, and on the other, national security is protected through the maintenance of technological competitiveness. The U.S. Commerce Department defines a supercomputer as one with a peak performance of 100 million floating-point operations per second. Whether such high-speed machines should be exported is just one issue of concern.

Even the mainframe market is being gradually dominated by the Japanese. In April 1989, Hitachi bought 80 percent of National Academic Systems, which was its American distributor. Amdahl Corporation is half-owned by Fujitsu and is IBM's strongest challenger. It has no choice but to sell higher-value computers.

The cause of trade imbalance is that it is becoming difficult to maintain a vibrant U.S. computer industry without a strong semiconductor business. Japan's computer industry has grown under MITI's protective barriers erected as far back as 1959. Japan controls the computer industry mainly because it controls the components. Toshiba's goal is to replace desktops in the United States with laptops, in which they have had great success. Sony entered the market two years ago to compete with Sun Microsystems for the lead in Unix-based workstations in Japan. The Japanese have a reasonable technical advantage in workstations, which are showing growth of 34 percent a year in sales. U.S. suppliers of designs for high-speed chips used in workstations have licensed Japanese companies, and this means their designs will be used for Japanese supercomputers and post-fifth-generation machines.

Space technology is Japan's stepping stone to the future. Building spacecraft and equipment is more demanding than working on the frontier of microelectronics. It is the most value-added of the high-tech systems. The principal firms in Japanese space technology are Mitsubishi, Nissan, and Ishikawajima, Harima for rockets, NEC, Mitsubishi, and Toshiba for satellites. The Japanese want to capture 20 percent of the world market for space applications by the turn of the century. The world market by the year 2000 is estimated at $25 billion. It is not a profit-making concern, but it is a strategic technology that the Japanese believe should be mastered. When NASA put a man on the moon, the Japanese were nowhere in the picture. Now Japan is building its own unmanned space shuttle called

WHAT SOME AMERICAN GIANTS REAP IN JAPAN

COMPANY	SALES* in millions, fiscal 1988
IBM	$8,800
Exxon	$6,700
Mobil	$5,900
Coca-Cola	$3,400
Caltex	$2,600
Du Pont	$791
Eastman Kodak	$750**
Motorola	$750**
Caterpillar	$741
Texas Instruments	$706
Hewlett-Packard	$613
NCR	$536
McDonald's	$535
Amway	$522
Digital Equipment	$510
General Electric	$506
Dow Chemical	$486
Pfizer	$438

*Adjusted to exclude Japanese share of joint ventures.
**FORTUNE estimate.

Sales of most U.S. companies in Japan comprise both imports and locally made goods. Profits are high.

SOURCE: ASIA ADVISORY SERVICE

FIGURE 4

Hope in order to move to manned spacecraft. The 1990 budget of the Japanese government for space development is $1.1 billion.

The Japanese in 1990 successfully tested an advanced rocket engine, the LE-7, which is an expendable launch rocket capable of carrying a two-ton payload. In 1969, the United States and Japan signed an agreement by which the United States had veto power over Japan's commercial launches of third-country satellites. The launch of the H-2 rocket in 1992 will free Japan from this condition.

Negotiations on satellite trade talks with the United States had deadlocked for several months. In April 1990, the Japanese government agreed to a compromise whereby it would give up its earlier insistence that its commercial CS-4 domestic communications satellite be wholly Japanese built. Under the new agreement, the CS-4 project will be integrated into an EDTRS project in which Japan would develop only academic research satellites of a life span not exceeding three years. The EDTRS is an experimental data-tracking and relay satellite. Japan also agreed to provide free access to foreign and domestic suppliers in procuring commercial satellites. So far, the United States had viewed Japan's satellite development as a discriminatory trade barrier and subject to the Super 301 retaliatory procedures on June 15, 1989. This example illustrates how the telecommunications rift between Japan and the United States has been growing since the imposition of the Super 301.

As the telecommunications industry matures with new technology, price warfare will betreduced and cartelization will increase. The FCC will probably step in to regulate the U.S. telecommunications industry. In Japan a similar trend toward telecommunications firms colluding is appearing. Japan's Fair Trade Commission is probing several Japanese firms accused of cartelized bid-rigging to win a telecommunications contract from the U.S. navy base at Yokota, near Tokyo. Japan's lax antimonopoly law has been blamed for such price-fixing cartels, which in 1989 rigged bids for the Kansai International Airport. This flaw in antimonopoly legislation is part of the SII talks held in February 1990.

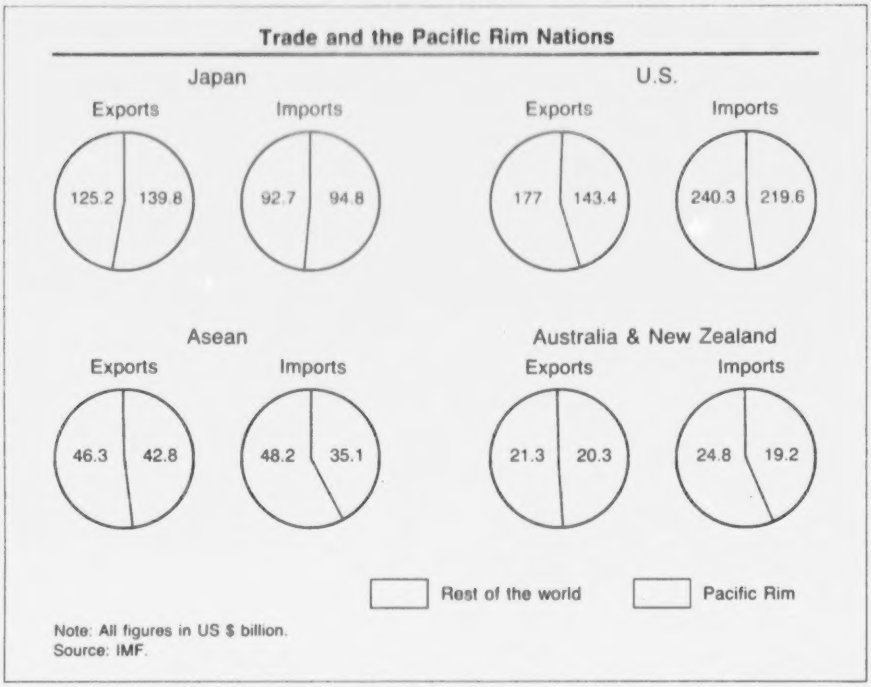
4. WHAT CAN THE GATT DO TO REDUCE THE TRADE CONFRONTATION IN THE TELECOMMUNICATIONS INDUSTRY

In April 1989, forty economists from around the world issued a statement on American trade policy. They argued that the possibility of managed trade using quantitative targets for judging the openness of markets and the retaliatory threats in bilateral contexts are not merely bad policies but will "bruise fatally, the GATT international trading system."

GATT came into the international regime for telecommunications in 1986 at Punta del Este when member countries agreed to initiate a separate charter for trade in services. Until that time, the ITU was the only international organization that dealt with telecommunications issues between member countries. Technology changed ITU's role when information exchange was replaced by information trade. With telematic services growing in volume the question arose: should trade rules be imposed on international telecommunications services? The role of services in international trade has been inadequately explored, and the quantification of the services sector, its productivity and pricing systems are only vaguely understood. Services do not fit the conventional trade theory, which considers them as intermediate goods, rather than final ones.

A group of Negotiations on Services (GNS) has been given four years to establish a multilateral framework of principles and rules for different services. The United States has already entered bilateral trade agreements with Canada, Israel, and Japan for semiconductors, and trade talks at a bilateral level are ongoing with Mexico. In all these, priority has been given to telecommunications and information services. The European Community is doing the same in its Green Paper in preparation for a unified single market program in 1992.

In November 1989, the United States Council for International Business, composed of three hundred major


Trade and the Pacific Rim Nations

Note: All figures in US $ billion.
Source: IMF.

FIGURE 5

multinationals, proposed a new approach for a General Agreement on Trade in Services (GATS). Its approach focused on telecommunications services provided under monopoly conditions as well as those provided under competition. It further suggested that such an agreement should be structurally flexible to accommodate changes in the industry occurring between this Uruguay Round and the next round of negotiations. The GNS is giving priority consideration in the crucial final stages of the GATT talks to telecommunications in terms of cross-border services as well as for access and use conditions for multinationals that have their internalized network systems to communicate with their subsidiaries. Other services such as banking, insurance, and tourism are so dependent on telecommunications that it becomes imperative to liberalize their trade. Telecommunications is considered a "covered service," which countries subscribing to the Uruguay Round would argue to be within the jurisdiction of GATT. The United States calls for an annex to the GATT Charter for defining public telecommunications networks and elaborating on provisions on access to the services of such networks. This annex would be a legally binding part of the agreement. It would apply to database services, electronic banking, and transborder data flows. The major elements in the annex would be transparency of internal regulations, progressive liberalization of competition, market access, national treatment, and access to public networks.

The potential benefits and adjustments for telecommunications service providers and users in Japan are the market openings for investment, joint ventures in countries that are signatories to the agreement, and greater freedom for users of international services. At the same time, Japan will need to revise its existing telecommunications law and MPT policies on ownership. Adjustments will also be called for on proliferation of technical standards.

Most of the trade problems between the United States and Japan were being addressed outside the purview of GATT and have more or less been settled in the same manner. The semiconductor chip agreement and the Super 301 were not part of GATT's procedures. The two countries in April 1990 reached a landmark interim agreement under which Japan pledged to open its markets to the United States. The USTR's Carla Hills had pledged in 1989 that she would use a "crowbar" policy to pry open Japan's markets and has succeeded in her efforts. The major agreements centered on Japan's *keiretsu* system of clubbing corporations, closed retail distribution, shortage of spending on public works, and lack of patent protection. Similarly, the United States will remove strategic impediments to trade on its side by encouraging savings, greater investment in education, R&D, and a reduction in the federal budget deficit.

In essence, the U.S.–Japan friction will decline as the United States has no longer formally designated Japan for unfair trade practices in the Super 301 as of the end of April 1990. The blocking by Japan of U.S. sales of supercomputers, satellites, and wood products had originally triggered retaliation. U.S. policymakers are still skeptical

TRADE ISSUES FOR 1990

EUROPE '92

The 12-nation European Community will be writing rules and product specifications that could restrict U.S. goods and services in the unified European market. That's already happened for U.S. television programming

THE U.S. WANTS

- ► To win rules that let American banks compete in the same markets as local institutions
- ► To avoid regulations forcing U.S. companies to locate plants in Europe or requiring use of local parts and raw materials

GATT

The current Uruguay Round of trade talks ends in December. A breakdown of the GATT talks could lead to the proliferation of trading blocs and a reduction of world trade

THE U.S. WANTS

- ► Elimination of agricultural subsidies
- ► Protection of services and intellectual property included under GATT rules

JAPAN

The 1988 trade act requires the U.S. to negotiate the opening of more Japanese markets this year or to take retaliatory action, which could escalate trade problems

THE U.S. WANTS

- ► Agreements on supercomputers, satellites, wood products, telecommunications equipment, and construction services
- ► Reforms in Japan's land-use policies, merchandise-distribution system, and closed government procurement processes

DEVELOPING NATIONS

Poorer nations are throwing up barriers to U.S. goods and services in order to protect new domestic industries

THE U.S. WANTS

- ► GATT protections against unfair barriers to U.S. services and protection from Third World software and entertainment media piracy
- ► Newly industrializing nations such as South Korea, Taiwan, and Thailand to relinquish GATT protection intended for poverty-stricken countries

DATA: BW

FIGURE 6

about the reduction in Japan's trade surplus because a weaker yen will help exports.

5. CONCLUSION

The main question facing policymakers is whether the breakthrough on trade with Japan in April 1990 will work. Will it help to reduce the $50 billion a year trade imbalance with Japan? The Japanese *keiretsu* system enables producers to fix prices and exclude foreigners, and Japan has promised to tighten its antitrust laws. This will also penalize large American companies like IBM Japan. The major problem is that Japanese consumers have accepted the price-rigging policies of suppliers and until they demand lower-priced imports, it will be difficult for U.S. exporters to pry open Japanese markets.

In terms of economic size and military strength, America has not lost its global reach. Its dominance may be declining, but in any age of global interdependence it is stability of investment and trade that will, in the long run, build prosperity both for Japan and the United States. Both countries need to encourage alliances and free-market measures to bring the developing countries within the ambit of the electronic revolution and its benefits. The fact that the ideals of democracy and modern capitalism have spread throughout Eastern Europe is a triumph for the dynamism of communication technology. There is a new look and a new tone in U.S.-Japan trade relationship since the April 1990 negotiations and SIT talks. While there were proposals and counter proposals on both sides, agreement to promote structural reforms in Japan were a welcome stepping stone to improved trade relations. The main objective of the April talks was to establish a "level playing field in trade." Case by case, trade reciprocity is being established in the industries named under the Super 301 clause—cellular telephones, supercomputers, and satellites.

In most cases, Japan has made concessions so that it is no longer named under the Super 301 clause promising reduced trade friction. But whether this will reduce the trade imbalance is questionable. More important is the fact that Japan is a powerful model of democratic devel-

Table 7A **Japan's Exports of Telephone Terminal and Switching Equipment to the United States, 1983–88**

(in thousands of dollars*, f.o.b. value)

	1983	1984	1985	1986	1987	January–October 1987	January–October 1988**
Key Telephone Systems	$30,634	$26,871	$28,053	$30,440	$34,054	$31,158	$16,587
Electronic Telephone Switchboards and Exchanges	36,878	37,908	18,098	23,744	21,464	16,798	24,917
Other Telephone Switchboards and Exchanges	10,332	10,194	941	0	14	14	
Desk and Wall Telephone Instruments	46,293	127,347	80,478	112,491	51,955	45,900	23,327
Other Telephone Instruments	71,121	149,248	123,452	122,021	176,342	153,378	197,708
Intercom Systems	3,724	4,389	5,129	5,147	5,869	5,303	4,064
Other Telephone Apparatus	13,691	9,833	4,639	2,206	2,395	2,261	1,458
Parts	171,358	420,953	266,346	309,348	279,809	234,287	239,544
Exports to the United States	384,030	786,743	527,137	605,397	571,902	489,099	507,604

*The following average annual exchange rates were used to convert the yen export figures: 1983, Y237.52; 1984, Y236.95; 1985, Y240.29; 1986, Y169.99; 1987, Y145.90; January–October 1987, Y148.03; and January–October 1988, Y128.99.

**In 1988 Japan switched its classification system from the Customs Cooperation Council Nomenclature to the Harmonized Commodity Description and Coding System. Therefore, the product categories for 1988 do not always match exactly those for earlier years.

Source: Japan, Ministry of Finance, ***Japan Exports and Imports: Commodity by Country.***

Table 7B **Japan's Imports of Telephone Terminal and Switching Equipment from the United States, 1983–88**

(in thousands of dollars*, c.i.f. value)

	1983	1984	1985	1986	1987	January–October 1987	January–October 1988**
Electronic Telephone Switchboards and Exchanges	$5,134	$6,927	$9,813	$14,799	$33,612	$30,136	} $57,646
Other Telephone Switchboards and Exchanges	2	7	4	0	0	0	
Other Telephone Apparatus	1,348	4,365	6,848	3,112	5,224	4,474	4,272
Parts	30,169	43,253	59,267	78,372	87,435	68,612	88,874
Imports from the United States	36,654	54,552	75,932	96,283	126,271	103,222	150,792

*The following average annual exchange rates were used to convert the yen export figures: 1983, Y237.59; 1984, Y236.91; 1985, Y240.17; 1986, Y170.08; 1987, Y146.01; January–October 1987, Y148.09; and January–October 1988, Y129.02.

**In 1988 Japan switched its classification system from the Customs Cooperation Council Nomenclature to the Harmonized Commodity Description and Coding System. Therefore, the product categories for 1988 do not always match exactly those for earlier years.

Source: Japan, Ministry of Finance, ***Japan Exports and Imports: Commodity by Country.***

opment in Asia. It is wedded to a Western economic system, it is committed to U.S. strategic objectives, and is becoming a cosmopolitan society. Its television programs and the life-style of its younger generation are taking the lead from the United States and more so since Sony's acquisition of CBS Records and Columbia Studios. Consequently, the new bilateral trade agreement provides a framework for the two countries to deal jointly with global concerns, whether it be Third World debt or environmental hazards. In short, much will depend on how Japan develops a worldview to complement its trade surplus.

Much of the success in telecommunications trade in Japan can be attributed to its economic disadvantages. The major value added to exports came from human skills and low-priced capital. Two oil shocks only served to increase Japanese production efficiency. They made their industrial structure large and homogenous to reap economies of scale and scope. They maintained their competitive advantage for exports by building new models of their electronic appliances. Innovation became the key for their export success, so they invested in large R&D projects. This enabled them to establish competitive ad-

Table 8A Japan's Exports of Telecommunications Equipment to the United States, 1984–89

(in thousands of dollars*, f.o.b. value)

	1984	1985	1986	1987	1988**	January–July 1988	January–July 1989
Key Telephone Systems	$26,871	$28,053	$30,440	$34,054	$21,293	$11,733	$14,523
Electronic Telephone Switchboards and Exchanges	37,908	18,098	23,744	21,464	} 28,191	17,496	20,332
Other Telephone Switchboards and Exchanges	10,194	941	0	14			
Desk and Wall Telephone Instruments	127,347	80,478	112,491	51,955	25,853	18,059	12,163
Other Telephone Instruments	149,248	123,452	122,021	176,342	248,974	122,195	98,991
Intercom Systems	4,389	5,129	5,147	5,869	5,167	2,715	2,163
Other Telephone Apparatus	9,833	4,639	2,206	2,395	1,860	838	1,742
Telephone Parts	420,953	266,346	309,348	279,809	287,237	171,460	184,254
Current Carrier Line Systems	68,245	152,759	176,567	170,597	319,346	198,707	136,039
Facsimile Equipment	167,267	290,016	253,939	568,385	984,555	487,269	536,496
Teleprinters	0	0	0	0	32	31	0
Citizen-Band Radios	8,058	5,970	6,341	7,389	4,539	3,483	714
Other Ratios	247,413	225,748	248,526	340,986	273,858	172,375	139,787
Radio Telephone Receivers	76,416	74,146	53,249	83,547	96,316	54,604	55,395
Radio Amplifying Tubes	2,490	2,118	2,236	2,008	112	46	76
Radio Parts	437,921	427,545	467,222	414,227	244,441	131,951	181,290
Communications Cable	6,215	7,471	11,831	14,525	7,298	4,361	17,882
Optical Fibers	0	0	0	0	95,129	66,852	5,863
Exports to the United States	1,800,768	1,712,909	1,825,308	2,173,566	2,644,201	1,464,175	1,407,710

*The following average annual exchange rates were used to convert the yen export figures: 1984, Y236.95; 1985, Y240.29; 1986, Y169.99; 1987, Y145.90; 1988, Y128.15; January–July 1988, Y128.89; and January–July 1989, Y135.74.

**In 1988 Japan switched its classification system from the Customs Cooperation Council Nomenclature to the Harmonized Commodity Description and Coding System. Therefore, the product categories for 1988 and 1989 do not always match exactly those for earlier years.

Source: Ministry of Finance, ***Japan Exports and Imports: Commodity by Country.***

Table 8B Japan's Imports of Telecommunications Equipment from the United States, 1984–89

(in thousands of dollars*, c.i.f. value)

	1984	1985	1986	1987	1988**	January–July 1988	January–July 1989
Electronic Telephone Switchboards and Exchanges	$6,927	$9,813	$14,799	$33,612	} $69,530	$41,935	$56,884
Other Telephone Switchboards and Exchanges	7	4	0	0			
Other Telephone Apparatus	4,365	6,848	3,112	5,224	5,595	2,854	10,925
Telephone Parts	43,253	59,267	78,372	87,435	105,005	59,603	56,309
Current Carrier Line Systems	17,774	23,680	27,076	28,931	50,694	24,356	36,247
Facsimile Equipment	616	1,806	4,444	5,379	4,916	1,229	2,191
Teleprinters	0	0	0	0	252	55	612
Radios Other Than Citizen Band	22,303	6,119	8,201	12,331	13,095	11,177	14,667
Radio Telephone Receivers	0	0	0	0	46,498	29,327	20,884
Radio Amplifying Tubes	3,693	3,603	2,049	3,907	2,799	1,803	1,607
Radio Parts	10,613	13,958	12,943	14,763	120,671	69,609	86,897
Imports from the United States	109,551	125,098	150,996	191,582	419,055	241,948	287,223

*The following average annual exchange rates were used to convert the yen export figures: 1984, Y236.95; 1985, Y240.29; 1986, Y169.99; 1987, Y145.90; 1988, Y128.15; January–July 1988, Y128.89; and January–July 1989, Y135.74.

**In 1988 Japan switched its classification system from the Customs Cooperation Council Nomenclature to the Harmonized Commodity Description and Coding System. Therefore, the product categories for 1988 and 1989 do not always match exactly those for earlier years.

Source: Ministry of Finance, ***Japan Exports and Imports: Commodity by Country.***

The top ten: Chip Suppliers

1972 1k DRAM	1975 4k DRAM	1978 16k DRAM	1981 64k DRAM	1984 256k DRAM	1987 1M DRAM
TI	TI	TI	Motorola	Hitachi	Toshiba
Motorola	Fairchild	Motorola	TI	NEC	Hitachi
Fairchild	National Semi.	National Semi.	NEC	Fujitsu	Mitsubishi
RCA	Intel	Intel	Hitachi	Toshiba	NEC
GE	Motorola	NEC	National Semi.	ATT Tech.	Oki
National Semi.	Rockwell	Fairchild	Toshiba	Mitsubishi	Fujitsu
GI	GI	Hitachi	Intel	Oki	TI
Corning	RCA	Signetics	Philips	TCMC	Matsushita
Westinghouse	Signetics	Mostek	Fujitsu	TI	—
American Micro Devices	American Micro Devices	Toshiba	Fairchild	Intel	—

Sources: 1972–81 Daniel Okimoto, Stanford University 1984–87 Dataquest Inc., San Jose, California

FIGURE 7

vantage in world trade and alter the image of Japan from "techno-bandits" to "miracle makers."

The tension in the U.S.–Japan relationship, as we have seen in this paper, is as much a reflection of myth as of reality. Industrial and trade prowess emerge from competition rather than collaboration. The economic detente that took place between the United States and Japan in April 1990 was timely and useful. It laid to rest some of the protectionist fears of the revisionist school in America. The revisionists hold that a self-oriented Japan is incapable of implementing free-market changes without external pressures from its trading partners. But it is as mythical to believe that Japan's uniqueness is dependent on protectionist barriers as it is to say that America is overburdened and in decline. With scant natural resources, Japan needs free trade as much as, if not more than, America does.

Both economic giants are interdependent. Their economies are interliked. If the United States took charge of its budget deficit, the U.S. dollar would escalate in value, and Japan's investments in the United States would be forced into decline, because they would not be so cheap in yen terms. Simultaneously, if the value of the dollar rose to 250 yeb, funds would flow out of Japan and force up its interest rates. As Omahae pointed out in an article in the *Japan Times* (September 13, 1989), "Japan's prosperity depends on the U.S. fiscal deficit." The general perception of unfairness prevalent both in America and Japan needs to be dispelled. Care must be taken to prevent trade reciprocity demands from spilling over into investment reciprocity, which would threaten the balance of global capital flows. A world of increasingly shared power needs leadership both from the United States and Japan in an information age of spreading pluralistic, democratic capitalism.

REFERENCES

Aranson, J. and Cowley, P. (1988). *When Countries Talk*, Ballinger Publishing Co.: Cambridge, Mass.

Chandler, Alfred (1990). *Scale and Scope*, Harvard University Press, Cambridge, Mass.

Emmott, Bill (1989). *The Sun Also Sets: The Limits to Japan's Economic Power*. Times Books, London.

Feldstein, Martin (1990). "Japan's Latest Export Promotion Plan," *Wall Street Journal*, 27 January.

Ishihara, Shintaro (1989). *The Japan That Can Say No*, cited in *Time Magazine*, November 20.

Jussawalla, Meheroo (1987). "The Race for Telecommunications Technology: U.S. versus Japan" *Telecommunications Policy*, U.K., September 11:3.

Jussawalla, M., Snow, M., and Braunstein, Y. (1988). "Major Issues in Information Services Trade," in *Trade in Investment and Services*, (Eds.) Lee and Naya, Westview Press, Boulder, Colo.

Lee, C. and Naya, S. (1988). "Patterns of Trade in Services," in *Trade and Investment in Services*, (Eds.) Lee and Naya, Westview Press, Boulder, Colo.

Oniki, Hajime (1989). "Japan's International Trade in Telecommunication Services," a paper presented in Seoul, Korea, mimeo.

Stein, Herbert. (1990) "Who's Number One? Who Cares?" *Wall Street Journal*, March 1.

Wilson, Dick (1989). "Where Trade Meets Culture: The U.S., Europe and Japan," *The Pacific Review*, Vol. 2:4.

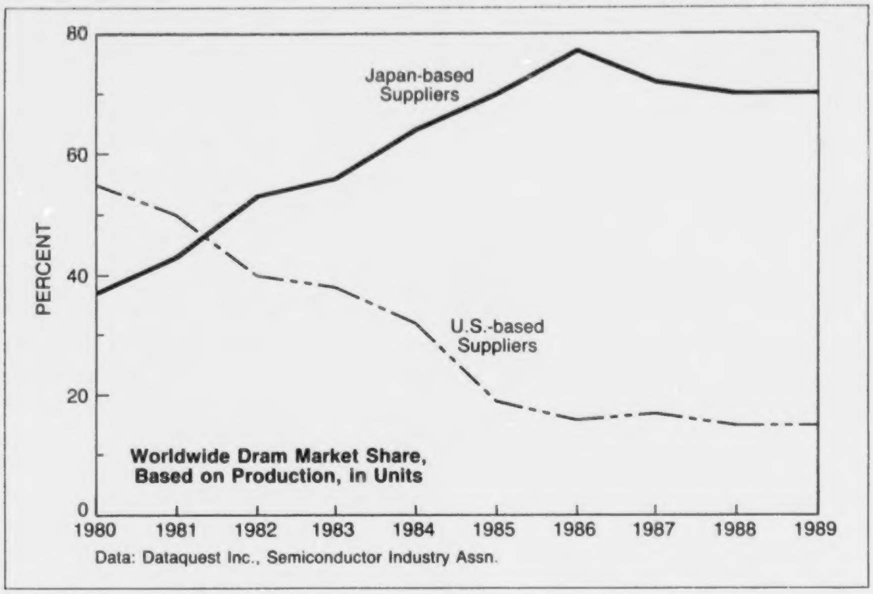


FIGURE 8

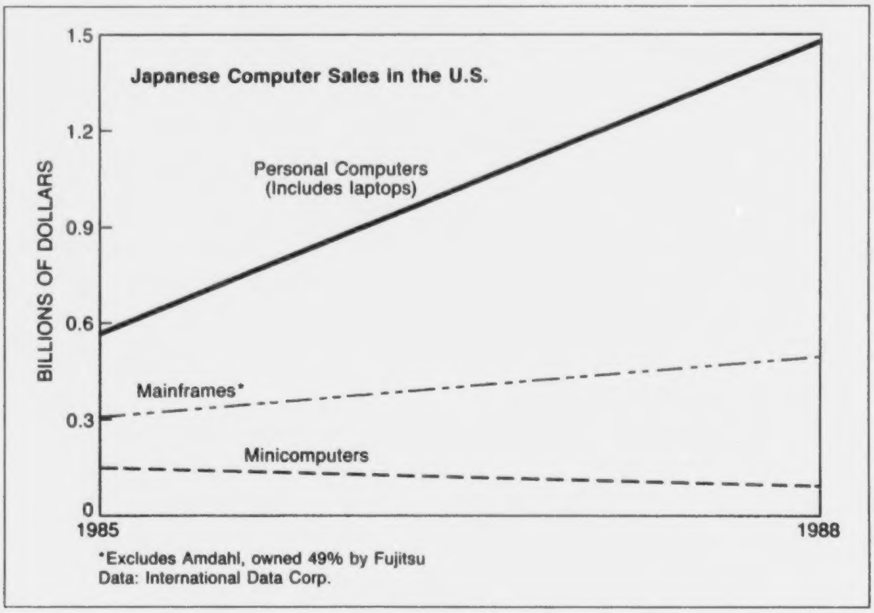


FIGURE 9

Introducing Direct Broadcast Satellite into Hong Kong:
Economic and Political Implications

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Abstract

The Hong Kong government has decided to deregulate the use of satellite master antenna television systems and allowed a satellite television service based in the territory. If a proposed first pan-Asian satellite television service is in operation in 1992, it will have significant economic and political implications in Hong Kong and the region.

I. Introduction

In November, 1990, Hong Kong's plan to introduce two new communication technologies simultaneously was shattered.

Two weeks after the Hong Kong government announced its policy to allow satellite television to originate and receive in the territory, the Hong Kong Cable Communications Limited (HKCC) abandoned its HK$7 billion (US$900 million) cable television (CATV) project.

Meanwhile, HutchVision, the company that originated the satellite television idea in Hong Kong, said it can offer the service in 12 months. If the Hong Kong government will issue a direct broadcast satellite (DBS) license in 1991, Hong Kong could be the headquarters of the first pan-Asian DBS service in Asia, using AsiaSat I as the carrier.

Now, Hong Kong's plan to build the world's largest CATV system is put on hold. The Hong Kong-headquartered DBS project has yet to be finalized.

These two projects are capital-intensive investments in Hong Kong. HKCC estimated that it will require six years and HK$7 billion (US$900) to wire the city. HutchVision said it will invest HK$3.1 billion (US$397 million) to start a six-channel pan-Asian DBS service. Hutch-Vision was the strongest contender in bidding the cable franchise before HKCC got the franchise in August, 1989.

When HutchVision proposed to base the first pan-Asian satellite television service in Hong Kong in June, 1990, HKCC strongly protested the co-existence of DBS or Satellite Master Antenna Television System (SMATV). HKCC said it would violate its exclusive subscription television franchise in the territory.

As it turned out, the potential competition between cable and satellite television in Hong Kong was a zero sum game.

Two weeks before the collapse of HKCC, HutchVision said it welcomed "a definitive policy decision by the government on the origination and reception of satellite television in Hong Kong." It added that "it (the decision) marks the beginning of what will become a new era in the communications history of Hong Kong and Asia."

Whether the telecommunications history in Hong Kong and Asia will enter a new era with the proposed introduction of DBS service remains to be seen. The Hong Kong government has yet to issue request for proposal. As an original proponent of DBS service, HutchVision has yet to announce its concrete plan. So, what I will cover in the paper here can only be a speculation on the economic and political implications if DBS is introduced in Hong Kong.

The paper will predict and evaluate the economic and political implications of introducing DBS service into Hong Kong. As the first pan-Asian DBS service, its impact also extends to the 2.5 billion populations covered in the footprints of AsiaSat I, the carrier of the DBS service.

Thus, the paper will identify the following economic, political and policy issues pertaining to Hong Kong:

1. Before the collapse of HKCC, the policy implication of the co-existence of DBS and CATV was: Because DBS might pre-empt CATV, what can the Hong Kong government do to allow DBS and CATV to co-exist and ensure CATV's exclusive franchise remain unchallenged? This is an important point to keep in mind because it helps us to understand the Hong Kong government's policy framework to regulate DBS.

2. As a new multi-channel television service in Hong Kong and Asia, what is the economic prospect of DBS, vi-sa-vis CATV in Hong Kong?

3. What role will DBS play in Hong Kong's sovereignty transition from the British to the Chinese in 1997? The 1984 Sino-British Agreement on the Future of Hong Kong stipulated that China will control Hong Kong's foreign affairs and national defense in 1997 when Hong Kong is an autonomous region of China. In view of this, would satellite transmission be considered foreign affairs and national defense that the DBS operation and programming content are subject to the Chinese government's approval? What if there is disagreement between the Hong Kong autonomous region administration and the Chinese government, who will have the final say? While these issues might not be imminent before 1997, the existence of DBS might signal Hong Kong citizens' basic human right to have access to information worldwide without a government's control.

In addition, the paper will identify the following issues related to the region:

1. What role would the programs play to serve the cultural interests in Asia? Would it promote cultural integration or cultural imperialism? Can it come up with an appropriate programming mix that would appeal to the culturally different audiences in the region?

2. Can the company that provides the DBS service refrain from involving in the regional politics when implementing the service? As a profit-making company, HutchVision might have put itself into a position of being forced to coordinate with different nations to discuss a solution to narrow their economic, cultural and social differences arising from DBS. Unlike the European DBS, which has the anticipated 1992 integration and a common organization for problem discussion and solving, the pan-Asian DBS raises the issue of finding an appropriate regional institution to discuss DBS issues, such as technical standards, programming and advertising standards, copyright, piracy violation enforcement, signal spillover disputes and other regulatory issues. So, would the necessity of addressing these issues jointly by the Asian nations help lead to a discussion of a stronger co-operation?

These issues are so complex that we may never find some satisfactory answers. The paper cannot fully discuss these issues. However, the identification of the issues is an essential starting point.

II. Who Are the Players in the DBS Game?

To better understand the issues and implications, it is necessary to point out the players involved.

Obviously, the Hong Kong government is directly involved. Its role is to set a policy that is fair and acceptable to all interested parties. However, the analysis of the government's policy in the next section will show that it lacks a coherent telecommunications policy.

HutchVision is another major player because it proposed the first pan-Asian DBS project in June, 1990.

Hong Kong Cable Communications (HKCC) was involved because SMATV was seen as a direct competition and threat to its economic survival in Hong Kong.

The Hong Kong media are involved because they served as a forum for the policy debates. More importantly, HutchVision has used the media to publicize its views and put pressure on the government. The most direct message from HutchVision to the government was its advertisement placed in an English-language newspaper in August, 1990. It announced publicly that if no decision was made by Dec. 31, 1990, HutchVision would have no choice but to abandon the project or move the DBS headquarters to other Asian countries.

The people of Hong Kong, who should be involved, were left out because they were not aware of the political and economic implications of DBS and CATV. It is also because the government has not done its job to explain the benefits and costs of this multi-channel television services. Some academics and professionals played their part in raising the issues. For example, writers of the "Global Telecommunications Watch" column in the Hong Kong Economic Journal had expressed their opinions before and after the Hong Kong government announced its DBS policy.

Other players who will be brought into the game are the Asian governments and people, whom the pan-Asian DBS service will serve.

III. Hong Kong Government's Policy on Satellite Television vi-sa-vis Cable Television

The Hong Kong government is not fully prepared to confront the policy issues on new communication technologies, including cable and satellite television. It lacks a multi-disciplinary institutional body to set the policy. The officials are not well-equipped in dealing with the new communication technologies issues. When the government cannot take effective measures, for example, in the HKCC and HutchVision media crossfire on the DBS/CATV issue, an official said the government was taking an "active non-interference policy."

(Please see Appendix I for a re-cap of events about the DBS/CATV fiasco in Hong Kong).

As a result, the private companies, equipped with their teams of local and international consultants, steer the direction of the policy process. The DBS/CATV fiasco shows clearly that HutchVision played a key role in setting the agendas of the policy process. It publicized its views directly and through well-orchestrated news leaks in the media.

At first, the government urged HKCC and HutchVision to discuss a possible collaboration. The issue was: Satellite can provide instantly a territory-wide television service through SMATV, however it would take HKCC six years and HK$7 billion to wire the entire city. Neither HKCC and HutchVision was willing to make any concession. Sandwiched between two big corporations, the Hong Kong government played referee in August by announcing some general policy principles. The policy then was to issue two separate licenses--one to SMATV operators and one to programming service providers.

1. To continue its plan to deregulate the use of television receive-only (TVRO) dishes in Hong Kong, the government will only regulate the dish owner if the dish is used to connect to only one television set. However, if the dish is connected to more than one television set, which is similar to a SMATV concept, the dish owner has to get a license.

In February, 1989, the Hong Kong government proposed the exemption of TVRO equipment from licensing and SMATV would not be licensed if it is confined within a building. This proposal would end Hong Kong Telecom International's exclusive right to receive satellite signals.

2. DBS operator in Hong Kong would be regulated by a broadcast license.

3. While the government did not specify whether the same company can hold the two separate licenses at the same time, it requires that:

a. The local DBS broadcast license holder will be responsible for programs originating from Hong Kong and overseas.

b. The local SMATV operator will be responsible for programs received from overseas sources. The SMATV operators have to ensure the program content meet the existing regulation standards. (The government later changed this.)

These policy objectives received many unfavorable comments. On Oct. 31, 1990, the Hong Kong government announced a more definitive policy framework. The following details were taken directly from the government's news release issued on Oct. 31, 1990.

The government said in a news release that the policy decision "took into account the degree of competition considered desirable between satellite television and existing or planned television services in Hong Kong, including cable television."

There will be two separate licenses for satellite television signals reception and origination (programming).

The SMATV requirements are:

--Only SMATV operators licensed by the Telecommunications Authority can install SMATV systems.

--SMATV operators will be allowed only to provide installation and maintenance of the equipment.

--SMATV operators will not be allowed to provide or package programs for distribution. They should not charge a subscription fee or collect a subscription fee for a program provider.

--SMATV operators cannot take cable across unleased crown land or public streets.

All SMATV operators will have to meet "standards of technical competence" laid down by the Telecommunications Authority and to provide adequate proof of good financial standing.

On the programming side, the government would make the Hong Kong-based satellite television programming principally for an audience outside Hong Kong. To ensure "equitability as regards to the interests of existing and planned television broadcasting in Hong Kong," the government required license holders to meet the following requirements:

> --They should not finance their business through subscription in Hong Kong during the six-year of HKCC's license exclusivity.
>
> --They should not rely principally on Hong Kong's local advertising market if they finance their business through advertising revenues.
>
> --They could not broadcast Cantonese-language programming, except that after three years, programs in Cantonese previously broadcast in Hong Kong could be broadcast and the government would then review whether newly produced Cantonese-language programs also could be broadcast. (Cantonese is the Chinese dialect used by 97% of Hong Kong's population.)
>
> --They should observe provisions in the existing code of practice on television program standards, except those related to time of broadcast.
>
> --They should not broadcast tobacco advertisements.
>
> --They should comply with existing advertising standards other than those not appropriate to a programming service intended to span several time zone and containing advertisements of foreign origin.
>
> --They should be responsible for ensuring that material broadcast by them did not infringe others' copyright and for taking all reasonable steps to ensure the acceptability of their programs in recipient countries.

In addition, the ownership of the license holders should be companies incorporated and registered in Hong Kong and not be subsidiaries of any other company. Major ownership would have to be in the hands of Hong Kong residents. (But the question of cross ownership and vertical integration was not specified). Furthermore, licensees would have to make payments to the government calculated on a percentage of that portion of their revenue deemed to be derived from Hong Kong. (The same principle applies to the cable franchise.)

A Hong Kong newspaper report quoted a government official as saying that more than one DBS license will be issued.

Before we would analyze further the economic and political implications of the policy framework presented above, it is necessary to understand the potential DBS programming service providers' plan.

IV. Potential DBS Programming Service Providers' Programming Plan

So far, HutchVision in Hong Kong is the only initiator and promoter of satellite television service in Hong Kong. Some Hong Kong newspapers showed pictures of the head of HutchVision project opened champaign bottles on the day when the government announced its DBS policy.

The following programming information of HutchVision was gathered from news reports published between June and December, 1990:

In July, 1990, HutchVision decided to lease 12 transponders of AsiaSat I. It included a "get-out clause" that gave HutchVision an option until Dec. 31, 1990 to abandon the project.

The Far Eastern Economic Review reported in June, 1990 that HutchVision was to provide six DBS channels, including international news, sports, movies, music and entertainment, one Japanese-language channel and one Cantonese-language channel.

In June, 1990, HutchVision said it will invest up to HK$3.1 billion (US$398 million) to provide the six channels. Programs receive in the first two to three years would be free of charge. The six channels would not be in service at the same time.

Then it floated the test balloon of creating a "Superstation" channel, which will carry re-run of programs of the two off-the-air television stations, ATV and TVB. ATV openly welcomed the idea. The "Superstation" aims at the 40 million ethnic Chinese in Asia. It would not violate the government's restriction on Cantonese-language programming because Mandarin is the language used.

In October, 1990, HutchVision said its channels will include five English-language channels and one in Japanese. It said its audiences are the expatriates working in the region, Japanese and overseas Chinese.

At first HutchVision estimated that it could attract at the most 5% of the 1.5 million households (about 75,000 households) if a Cantonese-language channel were part of the programming mix. When it knew that Cantonese-language programs were not allowed on DBS, it revised its potential audience base to 1%, basically the expatriates in Hong Kong.

Because HutchVision has prepared an elaborate study and programming plan when it was seriously contending for Hong Kong's exclusive cable franchise, it may have a well designed plan that has yet to be released to the public.

At present, a Japanese DBS service, Skyport, has tried to solicit subscribers in Hong Kong. A Hong Kong satellite dish owner can receive eight channels if he pays a monthly fee of HK$45 to HK$115 (US$8 to US$14) and buys a descrambler for HK$1,500 (US$188). The six channels include two English-language channels (Cable News Network and movies), variety shows, Asahi News, music television, Japanese dramas and other programs.

The Hong Kong DBS operators and government have not addressed of signals originating from outside Hong Kong. Doug Conn of Columbia University said in the panel discussion of the "Global Telecommunications Watch" column in November, 1990 that foreign SMATV operators might start beaming into Hong Kong with programming containing commercials. Thus, "The foreign DBS operator can benefit freely from reaching the Hong Kong consumer. But the Hong Kong DBS operator would not."

V. Economic Implications of Hong Kong Government's DBS Policy

The government has designed a very restrictive DBS policy in Hong Kong, intending to protect HKCC's exclusive franchise. However, even this effort failed to save HKCC from its demise. Does that mean the government will revise its policy to allow more breathing space for DBS to test its survival? It remains to be seen.

Jean-luc Renaud, a London-based consultant, said in the panel discussion of the "Global Telecommunications Watch" column in November, 1990 that the policy is "like cutting the wings of a chicken." He said "the Hong Kong government seems to send a signal that said we will allow you to exist but we do not give you the means to survive."

So, who is the clear winner in the new rules of the game? The SMATV operators. Their job is to install and maintain the dishes only. HutchVision estimated that about 80% of apartment buildings in Hong Kong have wired television reception systems. Another statistics show that there are about 40,000 apartment buildings in Hong Kong. A Hong Kong company specializing in installing satellite dishes said a satellite dish would cost between HK$30,000 to HK$150,000 (US$3,850 to US$19,230), depending on the reception quality. That means this could be an industry of between HK$1.2 billion and HK$6 billion (US$154 million and US$770 million) if all 40,000 buildings install satellite dishes. If each of the 1.5 million households will have to install a descrambler to receive the signals, the sale of descramblers, each sold at HK$936 (US$120), would total HK$1.4 billion (US$180 million).

If DBS can only attract 5% of the households in Hong Kong to install satellite dishes, the total sales of dishes would total HK$6 million to HK$300 million (US$770,000 to US$38.5 million). The total sales of descramblers would total HK$70 million (US$9 million).

This is the estimate for Hong Kong alone. The economic potentials will be more significant for the hardware industry (manufacturers, system installation and maintenance) in the Asia Pacific region.

(Please see Appendix II for a country by country analysis of satellite dishes in Asia.)

The demand for hardware will depend on the software (programs) available on the DBS service. The costs to provide DBS programs are very high. The European Sky Television service can be an example. Broadcasting magazine reported in February, 1990 that the four-channel service had accumulated losses of nearly US$340 million, including US$210 million during the last fiscal year and US$128 million in pre-launch costs. Sky Television's losses have increased to US$700 million in November, 1990.

It also reported that of the four channels--general entertainment Sky One, Sky Movies, the 24-hour Sky News and Eurosport--Sky Movies and Sky News represent the biggest fiscal drains.

So, the fact that the Hong Kong government prohibits DBS from charging subscription fees and restricts its local advertising revenues might force DBS to consider moving its base to other Asian countries. HutchVision has said six Asian countries, including Thailand, the Philippines, Malaysia, Taiwan and China (Shenzhen Shekou), have offered to accommodate its DBS service.

This raises another issue: Would other companies other than HutchVision enter the DBS bidding? In November, 1990, the British Satellite Broadcasting and Sky merged. It might suggest that even though the Hong Kong government intends to issue more than one DBS broadcast license, the fact is not many companies would take a risk in this capital-intensive venture.

Then the next question is: Whether running a single-channel would be economically feasible? The World Broadcast News reported in May, 1990 that a Hong Kong company, Capital Communications, is interested in investing US$7 million to offer a pan-Asian music television channel.

Whether more DBS companies exist in Asia also depends on whether another commercial satellite is available in the future. AsiaSat I is the first commercial use satellite in Asia employed for a commercial DBS service. If so, would the transponders be made accessible to all interested users on a fair tariff basis? Does this principle apply only the nation which owns the satellite or to the entire region? Would there be more frequencies for broadcast satellite in the sky in Asia? These are complex issue that needs to be explored more fully in a separate paper.

If the Hong Kong-based DBS project is in operation in Hong Kong, what will be its revenue sources? Advertising. The Hong Kong government further restricted the advertising revenue to only non-local advertising. This raises the question of how can the government determine local and international advertising?

Its intention is to protect the existing television broadcasting stations and cable television. As Milton Mueller of University of Nebraska--Omaha said in the panel discussion of the "Global Telecommunications Watch" column in November, 1990, "The restrictions on Hong Kong advertising is unfair and unnecessary. HKCC will rely primarily on subscription fees for its revenues, not on advertising. Perhaps the government is trying to protect the two existing broadcasters from competition. But if it wanted to do that, why did it license the cable system?"

As a pan-Asian advertising vehicle, the DBS might have specialized target audiences. Because it carries mostly English-language services and its target audiences are the elites in Asia who theoretically have high purchasing power. Its appeal to multi-national advertisers is it is the only audio-visual international vehicle to reach a mass audience. Then the question is: Do the advertisers want such kinds of audiences? Or do they prefer to tailor make their advertising messages to appeal to each country's cultural and social preference? This is an issue that needs more empirical research to determine its pros and cons.

VI. Political Implications of Introducing DBS into Hong Kong and the Region

Satellite television means the sky is the limit and there are no geographical boundaries in its signal transmission and reception. This forms the basis to discuss the political implications of DBS in Hong Kong and the region.

The "China factor" plays an important role in influencing Hong Kong's political and economic developments. This is more so during Hong Kong's transition to Chinese sovereignty in 1997. How is this "China factor" related to Hong Kong's introduction of DBS?

The immediate relation is the DBS service might have to carry Mainland Chinese and Taiwanese programs for its estimated 40 million ethnic Chinese in Asia. First, it is doubtful if the DBS operator can carry both Taiwan and Mainland Chinese programs on the same channel. Their ideological orientations are different. More importantly, some Asian countries would consider Mainland Chinese programs "propaganda materials." Taiwanese televisions stations also have close relationship with its government. Only Hong Kong's Chinese-language programs are not "official." Thus, to come up with a good mix of Chinese-language programs on DBS also would require some delicate political balancing.

The long-term relation of the "China factor" to the DBS service is DBS will be an international source of information to the local people. A lesson Hong Kong people learned in the June 4, 1989 Tiananmen incident is that access to international information sources is very important. The dishes in Hong Kong people's home might make it more difficult for the government in 1997 to control their information sources. In fact, some people in Taiwan have used the satellite dishes to learn about China through the Japanese NHK programs they receive.

The signal spillover from Japan to Taiwan was welcomed by some Taiwan people and have not been objected by the Taiwanese government. The World Administrative Conference in 1977 had addressed the issue of spillover. It stipulated that each country's signal should try to be confined to its national boundaries except with prior consultations. The 1982 United Nation's Declaration on Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting reaffirmed the WARC-77 principle and endorsed the right of states to block television broadcasts coming by satellite from abroad.

This raises the question of which international body should be responsible to settle the cross-national issues due to the introduction of DBS? The debates on DBS issues internationally have centered in three places: The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), UNESCO, and the International Telecommunications Union.

The issues need to be dealt with are DBS technical, programming and advertising standards, piracy enforcement, spillover disputes and other regulatory issues. Should the existing regional bodies, such as Asian Broadcasting Union, be asked to deal with the issues? Or should a new body be formed? Or would the DBS operator, such as HutchVision, has to coordinate such efforts? The answer is not clear-cut. It would be a challenge for the DBS operator to bring together all nations to discuss the issues.

Perhaps the European experience could be discussed here. The Commission of the European Community (CEC) and the Europe Broadcasting Union have tried to attain some pan-European standards before the first programs are beamed into households and any conflicts arise. The report, "Television Without Frontiers" published by CEC have raised two points: (1) DBS could play a role in helping the integration of Europe; and (2) DBS can help promote free flow of information among European countries. From an idealistic standpoint, if such spirit could be implemented in Asia, it would serve to (1) provide a better understanding among the Asian peoples; which might help promote a closer cooperation among them. Additionally, the free flow of information will benefit the region. For example, the idea of a pan-Asian news channel would help publicize the viewpoints of the Asian nations and might help balance the long-debated imbalance flow of information between the East and the West. In fact, HutchVision suggested that the creation of a "Superstation" will help promote the international image of Hong Kong.

The other side of the argument is such pan-Asian DBS would promote cultural imperialism from the West and open the doors to the invasion of Hollywood culture. Further, some would argue that DBS, as subscription television, would widen the information gap between the wealthy and the poor.

VII. Concluding Remarks

The issues raised in this paper are just some issues that need to be dealt with if DBS is introduced in Asia. Hong Kong government officials have denied that DBS caused the collapse of HKCC. However, DBS might have been the catalyst to cause the hastily-formed HKCC to pull out of the project. The uncertain future of using its second telecommunications network to provide voice and data transmission is another crucial factor.

As the situation now stands, it is more likely Hong Kong will have satellite television before cable television. Whether it is more desirable depends on the overall telecommunications goal of the Hong Kong government. The issue then extends beyond the introduction of multi-channel television services. HKCC's collapses challenges the government's vision of how to integrate the different new technologies to serve Hong Kong's telecommunications needs. It also raises the question of whether the Hong Kong government needs to revise its restrictive policy measures on satellite television.

A lesson can be learned from the DBS/CATV fiasco in Hong Kong is the government's antiquated communication policy needs a complete overhaul. The Hong Kong government treats the DBS issue as a "television broadcasting" issue because it acts on the recommendations of the Broadcasting Authority. The authority is comprised of government-appointed members who represent a wide range of interests. However, its policy implications go beyond broadcasting and Hong Kong's geographical boundaries. For example, in Europe, the DBS service providers can enter the telephony market. The United Kingdom has issued a consultative paper, "Competition and Choice: Telecommunications Policy for the 1990s." It proposes a sweeping liberalization of the markets, opening up local exchange, long distance, overseas services to competition and loosening restrictions on mobile, cable and satellite operators. If Hong Kong will follow suit, it would provide the Hong Kong-based DBS operator a better argument to ask other Asian countries to impose less protective measures to allow DBS to exist in their countries.

The zero sum game between cable and satellite television makes Hong Kong a unique model in telecommunications policy design. In the United States, cable operators (as the more experienced service provider) use their experience and expertise to help promote DBS in sales, marketing and programming. The availability of DBS programs on cable in the United States and Europe increases program choices. HKCC offered to include HutchVision's DBS channels on cable. But they failed to reach an agreement. One of the five partners of HKCC, Sun Hung Kai, estimated that DBS will take away 10% of cable subscribers, who are crucial to HKCC's initial opening. But by allowing the second telecommunications network to provide voice and data transmission would change the situation. Some say the interest of HKCC is not in the television broadcasting service but the more lucrative telephone market. Perhaps HutchVision's DBS proposal also has a hidden agenda. It might want to use satellite to build a regional and worldwide telecommunications network for its future expansion plans. These policy issues will surface once the DBS service is in service. Perhaps then the Hong Kong government will see the need of an inter-departmental and multi-disciplinary institution to design its policy.

The suggestion of introducing DBS into Hong Kong opens the first chapter in the evolving telecommunications policy in Hong Kong and Asia. How the book will be written depends on the collective wisdom of the business entrepreneurs, government officials, professionals, academics and peoples in the region.

Appendix I

A Re-cap of Events about the DBS/CATV Fiasco in Hong Kong

September, 1985
Broadcasting Review Board recommended the introduction of CATV in Hong Kong.

July, 1986
Eight companies expressed interest in the cable franchise, including Hutchison Whampoa Limited and Hong Kong Telephone Company (now the Hong Kong Telecom).

July, 1988
The Hong Kong government decided the CATV franchise holder will hold two licenses: the broadcasting license and the second telecommunications network.

February, 1989
Four Companies applied for the cable franchise, including Hutchison Whampoa. Also, the Executive Council advised the governor to exempt television receive-only equipment from licensing, ending Hong Kong Telecom International's exclusive right to receive satellite signals.

July, 1989
The Hong Kong government asked all cable franchise applicants to commit HK$5.5 billion (US$705 million) for the CATV project. Hutchison withdraw its application because of this government requirement.

August, 1989
Hong Kong Cable Communications was awarded the franchise. The consortium was comprised of Wharf Holding (28%), Sun Hung Kai (27%), US West (25%), Shaw Brothers Studio (10%) and Coditel (10%).

April, 1990
AsiaSat I was successfully launched. The company is comprised of Hutchison Whampoa Ltd., Cable and Wireless and China International Trust and Investment Corporation of the People's Republic of China.

June, 1990
Hutchison announced its plan to base its pan-Asian DBS project in Hong Kong. HKCC reacted quickly, saying the SMATV system will violate its exclusive franchise.

July, 1990
The Hong Kong government suggested the two companies could work out a collaborative plan. Both companies failed to come to an agreement.
An assistant secretary for recreation and culture (broadcasting and entertainment) said the Hong Kong government will take an "active non-interference policy" on this matter.

August, 1990
Hong Kong Executive Council said if more than one television set is hooked up to a satellite dish, no license is necessary. But if more than one television set is connected to a communal satellite antenna (SMATV), a license is require. Further policy framework would be announced later. Hutchison warned that if no decision was made before Dec. 31, it will have no alternative but to abandon its DBS service or move its headquarter to other Asian countries.

October--November, 1990
The Hong Kong government announced its satellite television policy. (See next section on Hong Kong government's policy for full details).
Hutchison initially welcomed the government's policy decisions and said it can provide the DBS service in 12 to 14 months.
HKCC announced that it will abandon its cable television project. The government said it will not impose any penalty on HKCC.

Appendix II

A Country by Country Analysis of Satellite Dishes in Asia

Country	Status	Dish Numbers
China	illegal	25,000
Hong Kong	licensed	unknown
India	legal	25,000
Indonesia	only to watch govt programs	250,000
Malaysia	neither legal or illegal	unknown
Nepal	legal	unknown
Pakistan	legal	1,000
Singapore	banned	no
South Korea	legal	150,000
Taiwan	small dishes legal	70,000
Thailand	licensed	unknown

Source: _Far Eastern Economic Review_, June 14, 1990, p. 39.

STRUCTURING FOREIGN INVESTMENTS IN FCC LICENSEES UNDER SECTION 310(b) OF THE COMMUNICATIONS ACT[1]

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This article discusses the Federal Communications Commission's treatment of foreign investment in companies subject to the restrictions imposed by Section 310(b) of the Communications Act and provides guidance and suggestions for structuring such investments in light of past FCC decisions.

The explosive growth and globalization of the communications industry has sparked a need for increased investment capital among American communications companies that cannot be met solely by domestic capital markets. In addition, the global marketplace has made it essentially impossible for international companies to ignore the potential benefits of establishing operations in a number of countries.

In the United States, Section 310(b) of the Communications Act of 1934 (the "Act") restricts foreign investment in a wide range of licenses granted by the Federal Communications Commission ("FCC"). However, the restrictions imposed by Section 310(b) do not prevent meaningful foreign investment in U.S. communications companies. By carefully structuring the investment, foreign investors may comfortably take a significant position in a company directly or indirectly holding licenses subject to Section 310(b), while Section 310(b) companies may gain a substantial infusion of funds from foreign sources.

I. APPLYING SECTIONS 310(b)(3) AND 310(b)(4)

Section 310(b) of the Act provides that no broadcast or common carrier or aeronautical en route or aeronautical fixed radio license shall be granted to or held by an alien, a foreign corporation, or

> any corporation of which any officer or director is an alien or of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country [Section 310(b)(3)]; [or]
>
> . . . any corporation directly or indirectly controlled by any other corporation of which any officer or more than one-fourth of the directors are aliens, or of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country, if the [FCC] finds that the public interest will be served by the refusal or revocation of such license [Section 310(b)(4)].[3]

Thus, Section 310(b) not only prohibits aliens and alien corporations from holding certain FCC radio licenses, but Section 310(b) also restricts both direct and indirect alien ownership interests in such licenses through Sections 310(b)(3) and (4).

The most significant difference between Sections 310(b)(3) and (4) is that the Section 310(b)(4) restrictions governing indirect ownership interests may be waived by the FCC upon a public interest finding, whereas Section 310(b)(3), which governs direct ownership interests, does not allow the FCC such discretion.

The first step in analyzing foreign investments is to determine whether Section 310(b)(3) or (4) applies. If the interest held by the alien is in a holding company controlling (holding a 50% or greater interest in) the licensee, Section 310(b)(4) applies, and the interest in the licensee held by the controlling holding company is not considered for Section 310(b)(3) purposes.[4] If an alien holds an interest directly in a restricted licensee or in an intervening company that holds a noncontrolling (less than 50%) interest in a restricted licensee, Section 310(b)(3) is applied.

To determine whether foreign ownership is within the Section 310(b)(3) or (4) limits, all direct interests held by aliens are aggregated, and all indirect interests held by aliens are aggregated.[5] The fact that these interests may be widely dispersed among multiple aliens from the same or different countries is irrelevant.

A. Use of the Multiplier

When determining the amount of alien ownership under Section 310(b), a multiplier is used to account for the diminution of influence on the licensee caused by successive layers of minority ownership in a vertical ownership situation. According to the FCC,

> the degree of influence over the licensee conveyed indirectly through minority stock ownership or voting rights in a company which, in turn, holds stock in a licensee is not as great as that conferred by the possession of the same amount of stock directly in the licensee.[6]

The multiplier looks at the product of each level of foreign interest. For example, assume that an alien investor ("AI") owns a 15% interest in Company X, which holds a 40% interest in Licensee. Because Company X does not "control" Licensee, Section 310(b)(3)'s 20%-interest benchmark applies, and the FCC would find that the AI owns a permissible 6% ownership interest in Licensee, the calculation being .15 x .40 = .06.

The FCC does not apply the multiplier where the ownership interest held by an alien in an intervening corporation or held by one intervening corporation in another intervening corporation is greater that 50% (except in the case of insulated limited partnerships and nonvoting preferred stock, as discussed below), reasoning that such a shareholder has actual control of the entity "which is unlikely to be significantly attenuated through intervening companies."[7] When the multiplier is not applied, the intervening corporation does not dilute the foreign ownership or voting interest for purposes of a Section 310(b) analysis.

B. FCC Discretion under Section 310(b)(3)

The FCC has repeatedly stated that it strictly applies the Section 310(b)(3) statutory restrictions and cannot waive the 20% ownership limitation or allow any foreign officers or directors of an FCC licensee because it lacks the express discretion to do so.[8]

C. Public Interest Waiver under Section 310(b)(4)

Where an entity controls a licensee (i.e., owns 50% or more of the equity or voting stock of the entity), Section 310(b)(4) is used to measure alien ownership interests.

Under Section 310(b)(4), the FCC *may* grant a license to an entity that does not meet the capital stock or officer and director restrictions of Section 310(b)(4) if the FCC finds that the public interest would be served by such a grant.[9]

The public interest analysis is undertaken by the FCC on a case-by-case basis and may involve the consideration of several different factors.

In 1987, the FCC enunciated four of the factors it has considered in the past in approving foreign investments exceeding the foreign participation limits of Section 310(b)(4):[10] (1) whether the alien's country of citizenship enjoys close and friendly relations with the United States;[11] (2) the extent of foreign ownership or control of the corporation (i.e., whether the alien holds a majority or minority share); (3) whether the licensed facility involved is passive in nature (i.e., where the licensee exercises no control over the content of the transmission, such as a common carrier);[12] and (4) the qualifications of the applicant.[13]

Other factors that the FCC has considered or might be persuaded to consider include the following: (1) whether the alien(s) exercises control over or supervises operations of the licensee subsidiary;[14] (2) whether the foreign participation raises any traditional FCC concerns relating to economic effects that may result from foreign investment;[15] (3) whether foreign participation will help to ensure the continued vitality of a business, thus preserving U.S. jobs and value to the company's stockholders;[16] (4) whether the transfer is temporary, as in the case of bankruptcy or default situations, and necessary to protect the interests of creditors;[17] (5) whether the transfer is necessary to save a failing company or will help to nurture an infant industry;[18] (6) whether the transfer will protect against deterioration in programming and station operations;[19] and, perhaps, (7) whether the alien's country of citizenship allows United States citizens to invest in similar licenses.[20]

D. De Facto Control Analysis

Even in cases where alien ownership does not exceed the statutory capital stock benchmarks under Section 310(b)(3) or (b)(4), the FCC's analysis will include a determination as to "whether . . . the alien will exercise *de facto* control over the licensee."[21] Any arrangement whereby an alien holds a sub-benchmark interest in a licensee may be scrutinized by the FCC for indications that the alien(s) nonetheless exercises *de facto* control over the licensee by virtue of any stockholder or voting arrangements.

For example, where an alien minority stockholder has full veto power on all or most issues, including financial plans, business plans, and other day-to-day operations of the licensee, the FCC would likely find the alien to be in *de facto* control of the licensee.[22] An analysis of what constitutes *de facto* control is an issue of fact, which is resolved in light of the particular circumstances involved.[23]

In *Seven Hills Television Co.*,[24] a Review Board of the FCC stated that the FCC "will not presume an impermissible measure of alien *de facto* control where the potential is highly remote or purely speculative. Conversely, where other direct or circumstantial factors animate that 'potential,' making improper *de facto* control not merely possible but almost probable," the FCC can act by withholding a license or taking some other action to implement the general statutory policy.[25]

Until *Seven Hills*, a long line of cases had held that the power of the purse is generally the power to control.[26] However, in *Seven Hills*, the Review Board noted that the FCC has diminished its emphasis on financial dominance as the controlling factor in its analysis of control.[27] Other factors are now equally important in making *de facto* control determinations. The FCC may consider, for example, who supplies the programming, whether interlocking ownership and/or management exists, and whether operating and/or management contracts effectively result in the domestic licensee surrendering authority to make decisions on day-to-day operations.[28]

In sum:

> The question of whether a minority investor may be in actual control of the company is governed chiefly by the demonstration of the power of the minority investor to dominate the

> management of corporate affairs. . . . A minority shareholder will not be viewed as in control of a company unless its influence is so great that it is able to determine the licensee's policies and method of operation or dominate the corporate affairs.[29]

II. EQUITY AND DEBT FINANCING UNDER SECTIONS 310(b)(3) AND (4)

According to the FCC, when Congress drafted Section 310(b) of the Act to apply to capital stock "owned of record" as well as voted by aliens, it intended to include substantial equity investments in whatever form.[30] The FCC has noted that while it is often stated that the purpose of Section 310(b) is to guard against actual alien control (through voting interests) rather than the mere possibility of control,[31] the broader purpose of Congress in adopting Section 310(b) was to "safeguard the United States from foreign influence in broadcasting [through substantial equity ownership interests]."[32]

In addition, despite the fact that both Sections 310(b)(3) and (4) reference only "corporations," the FCC has reasoned that, because the Act defines "corporation" broadly,[33] Congress intended to cover all business forms, including associations, corporations, and joint-stock corporations.[34] "[A]n overly restrictive administrative interpretation of the scope of [Section 310(b)] could provide the vehicle for complete circumvention of the alien ownership restrictions."[35]

Thus, in applying Section 310(b) to more than just voting stock in corporate entities, the FCC has "interpreted the term 'capital stock' . . . to encompass *the alternative means by which equity or voting interests are held in these businesses*,"[36] including interests of partnerships,[37] policyholders of a mutual insurance company,[38] members of a church,[39] members of a labor union,[40] and beneficiaries of an irrevocable trust.[41]

A. Corporations

For purposes of determining a corporation's compliance with Section 310(b), "[t]he term 'capital stock' is generally understood to encompass various classes of stock, including preferred stock," common stock, voting stock, nonvoting stock, and nonvoting stock that is convertible to voting stock.[42]

Unlike its treatment of voting stock, the FCC uses the multiplier mechanism to compute total ownership interest of nonvoting stock regardless of the amount held or whether it is convertible to voting stock.[43] For example, assume that (1) Company B owns 45% of Licensee; (2) Company A owns 45% of Company B; and (3) AI, the alien investor, owns 80% of the equity of Company A through nonvoting stock. Through the use of a multiplier, AI is deemed to own 16.2% of the licensee (.45 x .45 x .80), even though AI's interest in Company A exceeds 50%. If AI's 80% interest in Company A were voting stock, AI would be deemed to own 20.25% of the licensee (.45 x .45 x 1.00) because the multiplier would not be used, and AI would have been found to be in violation of the 20% statutory benchmark of 310(b)(3).

As noted above, the FCC broadly defines "capital stock" to include alternative means by which equity or voting interests are held. It would appear that there are a number of such alternative means. Many of these instruments effectively provide their holders with an equity interest in the company by allowing them to realize a capital return beyond any stock ownership.

Most common among these other forms of "equity" interests are convertible interests, such as warrants, convertible debentures, and options. While such convertible interests are widely viewed as "equity interests," the FCC has not sought to include convertible equity interests under its definition of the term "capital stock" for purposes of Section 310(b).

In numerous cases where convertible interests in a license were held by non-aliens, the FCC has not attributed ownership interests to these holders.[44] In cases where ownership or control by non-aliens holding convertible interests has been found, the FCC has identified other indicia of control, besides the convertible interests, as the reasons for its findings.[45] Most importantly, the FCC often places particular emphasis on whether a convertible interest requires prior approval by the FCC before conversion.[46] Such a requirement appears to make it less likely that the FCC will find that the holder of the convertible interest has *de facto* control.

In situations where aliens have held convertible interests in a licensee, a similar approach has been taken. The FCC has not categorically considered convertible interests as equity interests for purposes of Section 310(b). Rather, the FCC has reviewed such holdings in the larger context of whether the alien was in control of the licensee.[47]

B. Partnerships

While the FCC treats all "non-limited partners"[48] as officers and directors for purposes of the Section 310(b) limitations because they occupy positions comparable to those held by officers and directors in a corporation,[49] the FCC does not consider limited partners to be officers and directors if they are sufficiently "insulated."[50] These insulating guidelines essentially restrict limited partners from participating in the day-to-day operations of the licensee.[51]

Limited partners are treated as "stockholders" for purposes of Section 310(b).[52] The ownership interest they hold in the partnership is determined by equity contribution.[53] In calculating the ownership interests held by insulated limited partners, the FCC uses the multiplier discussed above "[r]egardless of the percentage of equity interest held by aliens in the limited partnership," so long as the limited partners are sufficiently insulated.[54]

C. Trusts

Because the FCC recognizes the use of properly designed trusts to avoid attributable own-

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ership for various purposes, trusts have been increasingly used to hold equity interests in FCC licensees.[55] It appears, because the language of Section 310(b) is limited to interests "owned of record," that a trust might be used by an alien to hold capital stock investments exceeding the investment restrictions in Section 310(b). The trustee of a trust is normally the owner of record of capital stock held in trust; therefore, an alien beneficiary would arguably be outside the reach of Section 310(b). In addition, the legislative history of Section 310(b) suggests that stock purchased by an alien for investment purposes could be placed in a voting trust to avoid violating Section 310(b).[56]

D. Debt

For purposes of Section 310(b), the FCC has taken the position that

> [t]he statutory guidelines contained in Section 310(b) are specifically couched in terms of equity ownership and voting benchmarks. . . . creditors do not possess either an ownership or voting interest over the licensee and consequently the direct restrictions embodied in Section 310(b) are not applicable to debt interests.[57]

However, despite this position, the FCC noted that it has the discretion to consider debt holdings for purposes of public interest findings under Section 310(b)(4).[58] In addition, as discussed above, the FCC has on many occasions considered debt in analyzing whether a licensee is subject to *de facto* alien control for purposes of Sections 310(b)(1) and 310(d).

III. STRUCTURING TRANSACTIONS TO ACHIEVE SIGNIFICANT ALIEN INVESTMENT UNDER SECTIONS 310(b)(3) AND 310(b)(4)

There are essentially two approaches alien investors and U.S. communications companies can take to structure permissible alien investments under Section 310(b) with significant alien participation.[59]

First, as discussed more fully below, the alien investor, AI, could structure the investment to comply with the Section 310(b) capital stock limits and include a number of "add-on" arrangements to maximize the alien's involvement. The precise structure of the investment will depend upon the ultimate objective of the parties involved -- that is, whether the objective of the investment is to maximize the amount of foreign capital which the licensee can obtain from one or more relatively "passive" alien investors or to maximize the return on the alien's investment and/or its role in the operation of the company. The AI need not obtain prior FCC approval of such an investment proposal but, in a close case, may choose to obtain a declaratory ruling from the FCC to ensure that the proposal complies with Section 310(b).

Second, the AI could seek a public interest finding from the FCC pursuant to Section 310(b)(4), based on the considerations discussed above, to permit the AI to hold more than 25% of the capital stock of a company controlling a licensee.

A. Maximizing Capital Stock Investment under Section 310(b)

Careful structuring of transactions involving vertical ownership chains and/or multiple classes of stock in a manner that takes full advantage of the FCC's multiplier mechanism can maximize alien capital stock investment under Section 310(b). For example, assume that a holding company, A, has an up to 50% interest in a company, B, which in turn controls an FCC licensee, C. AI could hold an interest of up to 50% in A and up to 20% in C. Thus, AI's maximum total interest would effectively be 45%.[60] Use of the multiplier is especially beneficial where limited partnerships and nonvoting stock are a part of the ownership structure.[61]

1. *Limited Partnership Interests*. The total amount of foreign capital available to a licensee or holding company of a licensee using a partnership structure under Section 310(b)(3) or (4) can be maximized by utilizing insulated limited partnerships. As discussed above, the FCC utilizes a multiplier for quantifying ownership interests held by insulated limited partners, even where the interest held is greater than 50%.[62] As a result, use of an insulated limited-partnership structure where a multilevel vertical chain of ownership exists can maximize the level of alien investment allowed for purposes of Section 310(b) calculations.

The following example illustrates how an entity, structured as a limited partnership and holding an interest in a licensee, can obtain greater amounts of foreign capital than an entity structured as a corporation. Assume that B, a U.S. holding company, controls a licensee, and U.S. citizens hold all other equity interests in the licensee.[63] A owns 30% of B, and AI, or a number of different AIs, owns 60% of A. If A is a corporation and the interests held by AI are common stock, the multiplier would not apply to AI's interest, which is greater than 50%. The level of alien investment in B is thus 30% (30% multiplied by 100%), which exceeds the Section 310(b)(4) threshold. Thus, AI is limited to a 50% interest in A in this scenario.

Now suppose that A in the above example is a limited partnership, with AI, an alien limited partner (or group of various alien limited partners), holding a 60% limited partnership interest. Assuming that AI is adequately insulated from the day-to-day operations of the licensee, the FCC would apply the multiplier. The alien ownership interest in B is thus 18% (30% multiplied by 60%). Thus, in this example, AI could hold up to approximately 83% of A in the form of insulated limited-partnership interests,[64] as compared to 50% of the capital stock when A is a corporation.[65]

2. *Nonvoting Stock*. Similar opportunities for maximizing the total amount of foreign capital invested in a holding company subject to Section 310(b)(4) exist where nonvoting stock is issued in place of common voting stock. Again, where alien investors hold less than 100% of a corporation in the

form of nonvoting stock, this interest will be diluted through the use of the multiplier, thereby allowing greater levels of investment than would be the case if common stock were held.

B. "Add-on" Arrangements to Maximize Alien Involvement

"Add-on" arrangements may be used to maximize alien involvement beyond the Section 310(b) capital-stock benchmarks. The choice of which add-ons to utilize in a particular transaction depends on the investment objective. Certain add-ons, such as options and debt, are particularly attractive to a Section 310(b) company seeking to infuse foreign capital from "passive" alien investors. Other add-ons, such as preferred dividends, investor protections, and management and turnkey arrangements, are especially appropriate for an alien entity wishing to maximize return on its investment and/or to obtain a more active role in the operation of the company.

1. Debt. Where a licensee seeks additional funds, debt structures may be the simplest way of obtaining capital without Section 310(b) implications. The FCC does not generally view debt agreements as ownership or voting interests.[66]

Because conditional interests are not normally considered "capital stock," convertible debt may facilitate alien investment in Section 310(b) licensees at a level above the capital stock benchmarks. Certain measures, such as creditor protections, may be used to provide the AI with some measure of influence over the licensee while providing a degree of protection of his investment. (See below.) Ideally, the debt instrument should include an express provision that conversion of the debt is precluded where such conversion would result in alien ownership in excess of the Section 310(b) benchmarks. Where the AI already holds a significant interest in a licensee and participates in the management of the licensee in some capacity, it is wise to structure the debt without contingent interests to avoid raising *de facto* control issues.

2. Transferable Option on Remaining Stock. The AI could invest directly or indirectly in the licensee up to the Section 310(b) limits and obtain a transferable option for the remaining ownership interest of the licensee, or a company holding the licensee, at an additional price. The FCC generally does not view such an option as "capital stock" or as an indicator of *de facto* control, so it is likely that no public interest finding under Section 310(b)(4) would be required. This option could not be exercised by the AI without such a public interest finding, but the option could be transferred by the AI to an unrelated U.S. party at a later date. This option enables the AI to take full advantage of a situation where the value of stock has risen considerably and also provides the AI with an element of additional influence in the licensee's affairs.

3. "Put" Option. It may be possible to include a "put" option in all shares of capital stock owned by the AI. A "put" option conveys to its owner the right, but not the obligation, to sell an asset, including stock, at a predetermined price (or pricing formula) until a certain date. This should not be considered a factor of "control" standing alone, since the AI has only the negative alternative of decreasing its ownership interest.

Thus, the licensee or a holding company of the licensee could offer the AI, for an amount above the price of the stock, an option that would allow the AI to sell back its interest at any time at some predetermined price. This arrangement would allow a greater amount of foreign capital to be invested in the licensee or its holding company, while providing the AI with a certain degree of influence over the licensee's board of directors and increased liquidity.[67]

4. Preferred Dividends. The licensee or its holding company could offer a separate class of stock to AIs, within the Section 310(b) benchmarks, which includes a preferred dividend feature. This arrangement would allow the AI to receive profits before, and possibly in amounts greater than, holders of other classes of stock. While this mechanism does not provide the AI with any greater control over the licensee, it allows the AI to recoup and benefit from its investment on a preferential basis, and an AI might be willing to pay some premium for such treatment. However, as discussed earlier, the increased amount paid in by the AI, if any, may be taken into account in calculating ownership interests.

5. Management, Traffic, Turnkey, and Other Agreements. Another possibility is for the AI to enter into certain management, traffic, or turnkey agreements with the licensee or its holding company in order to gain increased influence over and profits from the operations of the licensee. Through such agreements, the AI would also be assured of stability in the day-to-day operations of the licensee.

In the past, the FCC has approved management and traffic agreements where such agreements were found to have limited effects on the licensee's operations and be the product of arm's-length negotiations.[68] Thus, management and traffic agreements were permitted in *Licensee, Limited Partnership*. In that case, Licensee asserted, in its request for FCC approval ("Request"), that the agreements in question were the results of arm's-length negotiations and explained that, under the management agreement, Licensee would "make all operational decisions . . . particularly with respect to compliance with FCC rules and regulations."[69] The alien-controlled company's personnel would have "ministerial responsibilities for technical operation and maintenance . . . under the direction of Licensee."[70] The traffic agreement assured the alien-controlled company of the right to lease from Licensee up to 90% of the total capacity of Licensee's microwave facilities.[71]

In approving the arrangement, the FCC noted that safeguards designed to prevent undue control by aliens over the licensee existed -- either the licensee or the alien-

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controlled company's ultimate corporate parent, a Swiss company, could terminate the management agreement without cause upon thirty days' notice, and the alien-controlled company was prevented from modifying the facilities without written direction from the licensee.[72]

The FCC has also approved the provision of turnkey services to a licensee by an entity otherwise unqualified to hold an FCC license as long as the "turnkey arrangements do not involve the [provider] company in the operation and management of [the licensed] systems."[73] As long as a licensee's or its holding company's board of directors retains the power to make all final management decisions, an AI would arguably not have *de facto* control of the licensee, and such an agreement would pass FCC scrutiny.

De facto control can be found, of course, based on such agreements. For example, the FCC found Section 310(b) to be violated where a company transferred its FCC licenses for $1.00 to a company created for that purpose.[74] The same person was named as CEO of both companies, and, pursuant to a contract, the transferor was to exercise substantial control over the operations of the transferee after the assignment of licenses. Under the proposed transaction, the transferor would retain exclusive use of the facilities in question, and the transferee could not provide service to any other party without the transferor's prior consent. The transferor would be responsible for payment of the transferee's expenses, including salaries of its personnel and charges by vendors and other third parties pertaining to the communications systems. The FCC concluded that, "[w]hen viewed in their totality, the circumstances of this case do not indicate that [the transferee] will have exclusive control of the [licensed facilities]."[75]

In another example, the assignee/licensee and its U.S. holding company ("USHC"), which had a 20% alien shareholder, entered into a long-term contract whereby the assignee/licensee agreed to sell the bulk of its broadcast time to USHC.[76] The FCC found this agreement would allow USHC to be "very much involved in the activities" of the assignee/licensee and that this agreement, in combination with other factors, including the fact that the alien shareholder would furnish virtually all the funds for the acquisition of the licensee, raised substantial questions pertaining to *de facto* control of the assignee/licensee. The FCC set the case for evidentiary hearing on these issues, but apparently the application was subsequently withdrawn. It is possible, however, that an agreement for sale of broadcast time would be permissible on its face.[77]

6. *Separation of Assets*. The separation of restricted assets (i.e., FCC radio licenses subject to Section 310(b)) from nonrestricted assets is another approach that can increase foreign interests in a communications company. The restricted FCC licenses and, perhaps, the facilities essential to the operations of the licenses could be placed in an independent entity that would meet the FCC's foreign-ownership restrictions. All nonlicense assets could be placed in a separate, unrelated entity. The AI could acquire a 100% ownership interest in the entity holding the nonrestricted assets. The AI could also hold both 20% directly in the licensee entity and 25% in a holding company controlling the licensee.[78]

Where these types of arrangements are used, it is possible that the FCC could still find the AI to be in *de facto* control of the new licensee subsidiary.[79] Such a finding may depend on various facts, such as whether the AI owns the facilities arguably essential for the new licensee subsidiary's operations, and whether the AI would be able to dictate the new licensee's policies as to finances or personnel, or to control its management or method of operation.[80]

Thus, it is clear that care must be taken to maintain a sufficient degree of independence in transactions involving the transfer of a license to a new entity or the separation of restricted and nonrestricted assets. Although the FCC will allow significant involvement in the separate licensee's activities by other entities, the FCC apparently has set standards to ensure compliance with both the letter and spirit of Section 310(b).

7. *Staggered Board of Directors*. The articles of incorporation of the U.S. holding company could provide for staggered terms for its directors. Where a particular AI does not hold sufficient stock to elect favorable directors in the future, this add-on ensures that such directors are more likely to remain on the board in the short term. However, after a period of time, all of the original directors (presumably favorable to the AI) could be removed.

8. *Minority Shareholder/Creditor Protections*. To avoid raising Section 310(b)(3) and (4) issues and the need for FCC approval, investment in FCC licensees or their holding companies can be limited to the permitted benchmarks while separate shareholder or purchase agreements are entered into to protect the alien investor's minority interest. Similar protections may also be used by creditors.

The FCC has held that covenants intended to protect a minority shareholder's investment do not necessarily amount to *de facto* control, although extensive involvement in the day-to-day affairs of the company would likely be viewed as *de facto* control.

For example, in *McCaw Cellular*, the FCC scrutinized the investor protections, which included a requirement that the minority alien shareholder must approve the issuance of any new equity or the sale of the assets of the company. The minority alien shareholder also had the right to approve or block any changes in the company's bylaws. In addition, the minority alien shareholder's right to approve any changes in the company's lines of business was found not to equal control, because approval could not be unreasonably denied. The FCC implied, however, that approval over day-to-day operations or financial or personnel policies of the company may constitute *de facto* control.[81]

C. Additional Safeguards to Prevent a Finding of de Facto Control

The FCC may look more favorably upon the use of add-ons in an investment arrangement if safeguards designed to ensure compliance with Sections 310(b)(3) and (4) are also included.

Such safeguards may include redemption procedures or "call" provisions designed to allow the company to buy back shares of stock from aliens as necessary to ensure compliance with the Section 310(b) guidelines and to conduct regular surveys to determine the citizenships of shareholders.[82] The AI should also explicitly agree not to hold more than a statutorily permissible interest in the company (20% for Section 310(b)(3) and 25% for Section 310(b)(4)) without prior FCC approval. Conditioning the exercise of any options or convertible debentures upon FCC approval and/or compliance with Section 310(b) is recommended, and the FCC may require such a condition if it is not already included in the proposed arrangement.[83]

Most importantly, a "paper trail" should be left to document that the AI does not have de facto control. The AI should also refrain from utilizing too many "add-ons." Multiple "add-ons" increase the chance of the FCC raising the de facto control issue.

These safeguards, used in combination with the mechanisms described above, should provide the AI with greater protection of its investment and ensure the FCC of compliance with Sections 310(b)(3) and (4).

CONCLUSION

Section 310(b) was designed to limit foreign involvement with certain types of FCC licenses. In today's world, severely restricting foreign investment and participation in such licenses could significantly impair the efforts of United States communications companies to keep pace with new technologies and the increasing globalization of the industry. This would greatly endanger the United States' competitive position worldwide.

The proposals made in this article are designed to comply with both the letter and spirit of Section 310(b), while maximizing foreign investment and participation. Structuring transactions consistently with these proposals reconciles the intent of Section 310(b) with the growing need to allow alien investment in the U.S. communications industry.

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[1] This article is a condensed version of an article forthcoming in the California Western Law Review.

[2] The authors are associates with the law firm Skadden, Arps, Slate, Meagher & Flom. The opinions expressed in this paper are those of the authors and do not necessarily represent the opinions of the firm.

[3] 47 U.S.C. § 310(b)(3)-(4) (1982). The discussion in this article is essentially confined to limitations on broadcast and common carrier licenses, including radio, television, cellular radio, mobile radio, paging networks satellite, and microwave licenses. Due to a 1974 amendment, certain licenses, including microwave radio station licenses for Cable Television Relay Service (CARS), are exempt. 88 Stat. 1576 (1979).

[4] See Data Transmission Co., 59 F.C.C.2d 909 (1976) ("Datran III"); Data Transmission Co., 52 F.C.C.2d 439 (1975) ("Datran II"); Data Transmission Co., 44 F.C.C.2d 935 (1974) ("Datran I").

[5] See Request for Declaratory Ruling Concerning the Citizenship Requirements of Sections 310(b)(3) and (4) of the Communications Act of 1934, as amended, 103 F.C.C.2d 511, 521 (1985) ("Wilner & Scheiner").

[6] Id.

[7] Wilner & Scheiner at 522. The FCC relies upon its similar approach in Reexamination of the Commission's Rules and Policies Regarding the Attribution of Ownership Interests in Broadcast, Cable Television and Newspaper Entities, 97 F.C.C.2d 997, 1018 (1984), recon. granted in part, FCC 85-252 (released June 24, 1985) ("Attribution Order").

[8] Wilner & Scheiner at 518; PrimeMedia Broadcasting, Inc., 3 FCC Rcd. 4293 (1988) ("PrimeMedia"). However, in one case, the Commission "found" the discretion under Section 310(b)(3) to renew a license held by a party in a violation of Section 310(b)(3), contingent upon the prompt sale of the licensed property. Spanish Int'l Communication Corp., 2 FCC Rcd. 3336 (1987) ("Spanish International"), rev'd on other grounds, 893 F.2d 1349 (D.C. Cir. 1990) (per curiam).

[9] See, e.g., Comsat Gen. Corp., 3 FCC Rcd. 4216, 4218 (1988) ("Comsat General"); Wilner & Scheiner at 521 n.45. As the Commission has stated,

> the restrictions on foreign participation in companies that own or control a Commission licensee are not absolute. . . . [T]he Commission has the statutory authority [under Section 310(b)(4)] to evaluate whether or not, in a particular situation, it is in the public interest to permit a person to obtain or to hold a station license notwithstanding the fact that the alien interest in that station exceed the statutory benchmarks.

Millicom, Inc., 4 FCC Rcd. 4846, 4847 (1989), citing Wilner & Scheiner ("Millicom"). See also LCI Communications, Inc., Mimeo No. 3491, para. 3 (released Mar. 31, 1986) ("LCI Communications"); GRC Cablevision, Inc., 47 F.C.C.2d 467 (1974).

[10] Regulatory Policies and Int'l Telecommunications, 2 FCC Rcd. 1022, 1032 (1986).

[11] See also Comsat General at 4218 (Swedish, U.K., and Swiss citizens approved as 4 of 34 officers); Data Gen. Corp., 2 FCC Rcd. 6060 (1987) (U.K. officer approved) ("Data

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General"); Application for Consent to Transfer Control of Hughes Communications, Inc., 59 Rad. Reg. 2d (P & F) 502 (1985) (Canadian officer approved).

[12] See also Millicom at 4847 (common carrier microwave facilities are passive in nature); Data General at 6060 (Commission allowed alien officer of a DEMS licensee's parent, in part because this type of license is "passive" in nature); LCI Communications at para. 6.

[13] See also Data General at 6060 (alien officer's technical and managerial expertise found to be valuable in providing the public a new, high-quality service); Millicom at 4847 (invaluable communications expertise contributed by alien director); Houston Int'l Teleport, Inc., 2 FCC Rcd. 1666 (1987) (alien officer has valuable management, technical, and foreign-business expertise).

[14] While the FCC has approved alien officers and/or alien directors in excess of one-fourth of the board, the Commission often imposes a condition that the officers or directors not exercise direct control over a licensee within the corporate structure. See, e.g., Data Gen. Corp., slip op. (released March 26, 1986); Comsat General at 4218. However, such a restriction is not placed on aliens where the qualifications of the aliens are the reason for seeking a waiver under Section 310(b)(4). See, e.g., Data General at 6060 (FCC allowed foreign officer to participate actively in the operations of a DEMS licensee).

[15] In the past, the Commission has denied waiver requests in the context of the application of its international competitive carrier policies. See, e.g., Millicom at 4847; Competitive Carrier Policies, 102 F.C.C.2d 812 (1985), recon. denied, 50 Rad. Reg. (P & F) 1435 (1986).

[16] See, e.g., Millicom at 4848.

[17] Allowing a corporation that exceeds the Section 310(b)(4) benchmarks to be a transferee from a defaulting borrower for the limited purpose of finding a subsequent buyer/transferee appears to be consistent with the FCC's Second Thursday doctrine. Second Thursday Corp., 25 F.C.C.2d 112 (1970). In this case, the FCC took creditors' interests into account when deciding to allow the transfer of a license, despite the fact that renewal of license was subject to a hearing, where assignment was necessary to protect creditors and the licensee would not benefit from the sale. This equitable doctrine recognizes the public interest benefit of protecting creditors of licensees. See also Hertz Broadcasting, 57 F.C.C.2d 929 (1975) (FCC renewed license to permit assignment to qualified licensee to protect rights of innocent creditors); Shell Broadcasting, Inc., 38 F.C.C.2d 929 (1973) (FCC approved renewal of license and assignment of qualified licensee to ensure that creditors would be repaid).

(Footnote continued)

[18] See, e.g., Data General at 6060.

[19] See, e.g., Spanish International at 3339-40.

[20] The Commission is concerned with restrictive policies and practices of foreign governments which may impact its "ability to achieve the efficiency, equity, and national security goals set forth in the Communications Act." Regulatory Policies and Int'l Communications, Order on Reconsideration, 4 FCC Rcd. 323 (1984). The Commission has also considered the reciprocal treatment of U.S. communications companies by foreign governments in other contexts, such as foreign ownership in transoceanic cables, international record carriers, and domestic cable systems.

[21] Millicom at 4847 (1989). See also Wilner & Scheiner at 517 n.33.

[22] See, e.g., Satellite Transmission and Reception Specialist Company and Transmission Operator Provided Systems, Inc., DA 90-927 (released July 13, 1990) ("STARS/TOPS") (FCC found de facto control by alien-controlled company where CEO of the alien company was also CEO of the licensee and contract provisions between the two parties provided for exclusive use of the licensed earth stations by the alien-controlled company and responsibility by the alien for financial obligations incurred in connection with the operation of the stations); Applications of Pan Pacific Television and Silver King Broadcasting of Northern California, Inc. for Transfer of Control of Pan Pacific Television, Inc., 3 FCC Rcd. 6629 (1988) ("Pan Pacific") (substantial involvement by Taiwan minority shareholder in the financial affairs of licensee held to be a factor indicating de facto control).

[23] Stereo Broadcasters, Inc., 55 F.C.C.2d 819, 821 (1975); Metromedia, Inc., 98 F.C.C.2d 300, 306 (1984).

[24] 2 FCC Rcd. 6867 (1987) ("Seven Hills").

[25] Id. at 6876 (citations omitted).

[26] See, e.g., George E. Cameron, Jr. Communications, 93 F.C.C.2d 789, 812-15 (Rev. Bd. 1983); WLOX Broadcasting Co. v. FCC, 260 F.2d 712 (D.C. Cir. 1958); Heitmeyer v. FCC, 95 F.2d 91 (D.C. Cir. 1937).

[27] 2 FCC Rcd. at 6880 (discussing KIST Corp., 102 F.C.C.2d 288, 290-92 (1985), aff'd sub nom. United Am. Telecasters, Inc. v. FCC, 801 F.2d 1436 (D.C. Cir. 1986), where Com-

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mission held that a financial investment was not the "sine qua non of legal control, just one of several indicia . . ."). But see Pan Pacific, 3 FCC Rcd. 6629.

[28] See, e.g., Seven Hills at 6880, 6881; Licensee, Limited Partnership, 5 FCC Rcd. 1673 (1990) ("Licensee") (Commission approved a management agreement that was the result of arm's-length negotiations between an alien-controlled company and licensee whereby all operational decisions would remain with the licensee).

[29] McCaw Cellular Communications, Inc., 4 FCC Rcd. 3784, 3789, aff'd, 4 FCC Rcd. 4865 (1989) (citation omitted) ("McCaw Cellular").

[30] Wilner & Scheiner, 103 F.C.C.2d 511 (1985), recon. in part, 1 FCC Rcd. 12, 15 n.13 (1986) ("Wilner & Scheiner Recon.").

[31] See, e.g., Wilner & Scheiner at 516 nn.29-30, citing Datran II. See also PrimeMedia at 4294.

[32] Wilner & Scheiner at 517; PrimeMedia at 4294.

[33] See 47 U.S.C. § 153(j) ("'Corporation' includes any corporation, joint-stock company, or association.").

[34] Wilner & Scheiner at 514.

[35] Id. at 515, citing Kansas City Broadcasting Co., 16 F.C.C. 667, 5 Rad. Reg. (P & F) 1057, 1094 (1952).

[36] PrimeMedia at 4293, 4295 (1988) (emphasis in original), citing Wilner & Scheiner at 516.

[37] Wilner & Scheiner.

[38] Farragut Television Corp., 4 Rad. Reg. 2d (P & F) 350 (1965) ("Farragut Television").

[39] Kansas City Broadcasting Co. at 1094.

[40] Chicagoland TV Co., 4 Rad. Reg. 2d (P & F) 747, 752 (1965), application for review denied, FCC 65-367 (released May 5, 1965).

[41] PrimeMedia.

[42] Wilner & Scheiner at 513, 519, 521 ("Any ownership or voting interest held by an individual other than a United States citizen or by an entity organized under the laws of a foreign government is counted in the application of the statutory benchmarks."); see also Spanish Int'l Communications Corp., 4 FCC Rcd. 2153, 2154 (1989) ("[V]oting and non-voting stock interests are indistinguishable for purposes of section 310(b)." (citation omitted)).

[43] Wilner & Scheiner at 521-22. (The FCC's use of the multiplier for nonvoting stock regardless of amount held is based on the policies adopted in Attribution Order.).

(Footnote continued)

[44] See, e.g., M&M Broadcasting Co., 26 F.C.C.2d 35, 17 Rad. Reg. (P & F) 1254 (1959); Atlantic Coast Broadcasting Corp. of Charleston, 22 Rad. Reg. (P & F) 1045 (1962); KSOO-TV Inc., 19 Rad. Reg. (P & F) 28 (1959); Belo Broadcasting Corp., 49 F.C.C.2d 181, 31 Rad. Reg. 2d (P & F) 944 (1974); WDUL Television Corp., 33 F.C.C. 149, 22 Rad. Reg. (P & F) 545 (1962).

[45] See, e.g., Integrated Communication Sys., Inc. of Massachusetts, 14 F.C.C.2d 698, 14 Rad. Reg. 2d (P & F) 372 (1968) (terms limiting the licensee's ability to exercise control over the station (e.g., salaries, liabilities) when combined with option to acquire all stock resulted in de facto control).

[46] See, e.g., KSOO-TV, Inc. at 32; Belo Broadcasting Corp. at 184; Coral Television Corp., 29 F.C.C.2d 266, 278, 21 Rad. Reg. 2d (P & F) 1114, 1127 (1971).

[47] See, e.g., Spanish Int'l Communication Corp., Initial Decision F.C.C. 86D-1 slip op. (released Jan. 8, 1986) at 6; Application of Zeather Willis, Hearing Designation Order, MM Docket No. 85-27, slip op. (F.C.C. Feb. 12, 1985); Datran I at 937; Datran II at 439-40; Datran III at 910-11; and Channel 31, Inc., 45 Rad. Reg. 2d (P & F) 420 (1979).

[48] "Non-limited partners" is defined to include both general partners and partners in partnerships without limited partners. Wilner & Scheiner Recon. at 15 n.4.

[49] Wilner & Scheiner at 520-21 n.43; Wilner & Scheiner Recon. at 520 n.42; Continental Cellular, 5 FCC Rcd. 691 (1990).

[50] Wilner & Scheiner at 520-21 n.43.

[51] Reexamination of the Commission's Rules and Policies Regarding the Attribution of Ownership Interests in Broadcast, Cable Television and Newspaper Entities, FCC 85-252 (released June 24, 1985), 50 Fed. Reg. 27,438, 27,446 (July 3, 1985) ("Attribution Recon.").

[52] Wilner & Scheiner at 520.

[53] Wilner & Scheiner at 520 n.42. In deciding to define ownership for purposes of 310(b) pursuant to equity contribution, the Commission noted that it may revisit this issue in the future and define it pursuant to partnership share. This would allow a greater level of alien investment.

[54] Id. at 522 n.49.

[55] See, e.g., Twentieth Holdings Corp., 4 FCC Rcd. 4052, 66 Rad. Reg. 2d (P & F) 906

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(1989); *Lorimar Telepictures Corp.*, 3 FCC Rcd. 6250 (1988).

[56] *Hearings on S. 2910 Before the Comm. on Interstate Commerce*, 73d Cong., 2d Sess. 131 (1934).

[57] *Wilner & Scheiner* at 519 (footnotes omitted).

[58] *Id.* at n.38, *citing Datran III*.

[59] Of course, the easiest way for foreign investors to handle Section 310(b) restrictions is to invest in communications properties not subject to Section 310(b), including, for example, (1) nonradio telecommunications companies (e.g., carriers utilizing fiber optics); (2) cable television operators; (3) private microwave systems; and (4) separate satellite systems.

[60] The calculation: .50 x .50 + .20 = .45. The alien interest in any FCC licensee ownership structure cannot exceed 45%, as is evident from the simpler case where the AI holds a 20% interest in a licensee and a 25% interest in its holding company (.20 + .25 = .45).

[61] This paper does not consider the possible income tax consequences of these various investment arrangements.

[62] Again, a multiplier is not used in corporate vertical ownership chains where the ownership interest in capital stock is greater than 50%.

[63] Section 310(b)(4) is thus applicable.

[64] The calculation is as follows: .30 x .83 = .25.

[65] Under the FCC's current policy, the general partner in such a limited partnership may have contributed only 1% of the partnership's equity but can still be deemed to be in control. However, it is possible that the Commission may evaluate this situation differently in the future -- that is, where the general partner has contributed only nominal equity and the alien limited partners have, in effect, financed the entire venture.

[66] However, the FCC has considered debt in analyzing whether a licensee is subject to *de facto* alien control for Section 310(b)(4) purposes, especially when the debt is a substantial part of the licensee's capitalization.

[67] While it may be possible to argue that a "put" represents an equity interest in the licensee, the FCC has generally not included such interests under the term "capital stock" for purposes of 310(b).

[68] *See, e.g.*, *Licensee*; *see also* Public Notice No. 1932, *Private Radio Bureau Reminds Licensees of Guidelines Concerning Operation of SMR Stations Under Management Contracts* (released Mar. 3, 1988) (a Specialized Mobile Radio ("SMR") licensee is permitted to hire another entity to manage its SMR system so long as the licensee does not contract away control of its system).

(Footnote continued)

[69] Request at 8 (dated September 26, 1989).

[70] *Id.*

[71] *Id.* at 9.

[72] *Licensee* at 1673.

[73] *Bloomington-Normal MSA Ltd. Partnership*, 2 FCC Rcd. 5427, 5429 (1987); *see also Mobile Services Division Releases Guidance Regarding Questions of Real Party in Interest and Transfers of Control for Cellular Applications in Markets Beyond Top 120*, 1 FCC Rcd. 3 (1986) (The FCC provided a checklist of factors to consider in determining whether a tentative transferee or selectee of a cellular license has retained control of and responsibility for its facility in the context of arrangements to obtain services from another company: (1) Does the licensee have unfettered use of all facilities and equipment? (2) Who controls daily operations? (3) Who determines and carries out policy decisions, including preparing and filing applications with the FCC? (4) Who is in charge of employment, supervision and dismissal of personnel? (5) Who is in charge of the payment of financing obligations, including expenses arising out of operations? and (6) Who receives monies and profits derived from the operation of the facilities?).

[74] *STARS/TOPS*.

[75] *STARS/TOPS* at ¶ 14.

[76] *Channel 31, Inc.*, 45 Rad. Reg. 2d (P & F) 420, 423 (1979).

[77] *See also Telemundo, Inc. v. FCC*, 802 F.2d 513 (D.C. Cir. 1986) (In connection with a sale of the licensee to Television Broadcasting Corp. ("TBC"), affiliates of TBC's primary shareholder, an alien corporation, entered into five-year management, production, and programming contracts with the licensee. The Court of Appeals upheld the Commission's conclusion that the cancellation of these contracts, along with a reduction in alien stock ownership in TBC, reduced alien influence in the licensee's activities to an acceptable level. The Court also noted, as the Commission had done, that American citizens had been retained "to provide the management services that were the subject matter of the voided contracts." *Citing Zaida Perez Vda. de Perez Perry, et al. and Television Broadcasting Corp.*, FCC 85-381 (July 26, 1985)).

[78] *See*, *e.g.*, *Licensee*.

[79] *See*, *e.g.*, *James F. Rill*, 60 Rad. Reg. 2d 583 (P & F) (1986) (*de facto* control exists where a minority shareholder has sufficient influence to "determine" the licensee's policies and operations, or "dominate" corporate affairs).

[80] *See*, *e.g.*, *STARS/TOPS*.

[81] *McCaw Cellular* at 3790.

[82] *Id.*; *see also* *Farragut Television*.

[83] *Datran II* at 441.

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MOBILE RADIO NETWORK PLANNING FOR OPTIMUM SPECTRUM UTILISATION

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ABSTRACT- The paper considers various techniques adopted for spectrum conservation in mobile radio communication systems. Network planning to meet the objective of serving large number of users distributed over a vast area, while using a relatively small radio spectrum is described. Regular lattice, its geometrical parameters and the frequency reuse concept of network planning are discussed. The frequency reuse here refers to the use of same radio channels in different areas separated from one another by sufficient distance, so as to ensure that mutual interferences are reduced to a tolerable level. The system is realised as a network of contiguous cells, with each cell serving an area upto and into that of adjacent cells. The effect which this approach has on spectrum management is discussed.

1. INTRODUCTION

Every mobile radio network is planned with the objective of providing continuous communication to mobile subscribers which occupy arbitrary locations in the service area. This is contrary to a conventional radio communication system which has a limited service area capability. The conventional system is usually designed by selecting one or more channels from a specific allocated frequency band for use in the service area and is plagued by inefficient spectrum utilisation. The problem becomes more critical in a spectrum limited environment, where the success of a network is strongly influenced by how efficiently the available frequency spectrum is utilised.

A mobile radio communication system is usually required to operate over areas too large to be economically covered by a single base station. The requirement, therefore, exists for an area coverage technique using number of base stations. When a number of base stations are used to provide total area coverage, it is desirable to reuse the radio frequency channels within the service area. However, this solution introduces interferences unacceptable to the subscribers of the system. The interferences which occur within the network and should be taken into account in frequency planning are co-channel interference, adjacent channel interference and intermodulation. Keeping the level of interference too low will result in an inefficient spectrum conservating approach. Whereas, keeping this level too high will create signal anomalies. Therefore, the network has to be carefully planned to achieve a balance between spectrum utilisation and signal degradation.

2. SPECTRUM CONSERVATION

The network plan is influenced by the approach adopted for spectrum management. Packing the communication channels closely and employing frequency reuse technique are two obvious means of spectrum conservation. Important typical approaches based on these concepts which can be considered in network planning are discussed briefly. [2],[9].

Narrow Band or SSB Approach : SSB modulation scheme is quite effective in spectrum conservation for point to point communication systems. The attraction for mobile applications is obvious as it appears that already congested frequency spectrum can service twice the number of subscribers using the same frequency band. However, a mobile radio network would then require smaller cells but with larger separation between the cells using same frequencies, in order to provide the desired voice quality. This results into usage of more number of radio channels for total area coverage and hence the requirement of a larger spectrum as compared to FM system which requires few numbers of larger cells with less separation between co-channel cells.

Frequency-hopped Approach : The frequency hopping scheme in FDMA can be used in planning a mobile radio system. In a FH system, an orthogonal arrangement of distribution of channels is used i.e. all the frequencies in use are different at any one instant. The size of the cell increases for the same number of channels. Thus the frequency hopping system enables to serve a large number of subscribers with limited radio spectrum. When the FH technique is used in every adjacent cell, the co-channel cell interference affect the FH system performance adversely. Guard bands are usually used for adjacent frequency channels which result into inefficient spectrum utilisation.

Spread Spectrum Approach : The spread spectrum technique in TDMA has the advantage that the number of radio channels required to serve large number of subscribers can be reduced. It can also achieve better efficiency in bandwidth utilisation because no guard band is required between channels. The main disadvantage of TDMA is the requirement of the accurate clock. Inaccurate clock results in delay spread, transmission time delay and the signal degradation. This approach for spectrum conservation is suitable for microcell system i.e. cells having radii of 1-2 Kms.

Cellular Approach : The cellular approach is the most sophisticated and efficient technique for total area coverage using limited radio spectrum. The 30 KHz FM cellular system is about as spectrally efficient as the hypothetical 3 KHz SSB system and much more efficient than either of the 5 KHz or 7.5 KHz SSB systems. Comparing this with a frequency hopping DPSK modulated system it is seen that the spectral efficiency of the systems are the same. The fundamental concept in cellular approach is frequency reuse. However, the design need careful planning to avoid degradation in the voice quality because of co-channel and adjacent channel interferences.

3. AREA COVERAGE

Area coverage is defined as the area within which continuous communication must take place. A mobile radio communication system generally operates over large areas and hence requires a number of base stations to provide total area coverage. This requires incoming desired signal to be compatible to the receiver noise in the service area.

With negligible environmental noise, the minimum useable received signal level Pr equals the receiver sensitivity level Prs. We then have :

$$Pr \geq Prs \qquad (1)$$

The area covered by a base station is defined by the service radius R and is the distance from the transmitter at which the median signal strength decreases to a level corresponding to the useable signal level at the receiver. The service radius depends on the system parameters and the radio propagation loss between the transmitter and receiver. This is conventionally deduced from the median value of propagation loss. [3],[4].

Coverage Plan : The propagation considerations recommend the circle as a cell shape for defining the area covered by a particular base station. But this is impracticable for design purpose, since an array of circular cells produce ambiguous areas which are contained either in no cell or in multiple cells. On the other hand any regular polygon can cover the service area with no gap or overlap [1],[7]. A system can be planned with square or equilateral triangles, but the regular hexagonal shape results in the most economical system design [6], with the length of the hexagonal side equal to the radius of circumscribing circle. With this technique it is possible to achieve a coverage efficiency of 83% as compared to an efficiency of 64% as achieved with a regular square lattice. The ideal value is obviously one, but is not attainable as it is not possible to cover an area with circles.

In principle, the spacing between the base stations need not be regular and the cells need not have any particular shape. But in practice, the absence of an orderly geometrical structure would make the planning more cumbersome and will result in an inefficient use of spectrum and uneconomical deployment of base stations.

4. FREQUENCY REUSE

A special rule governs the frequency assignment when a number of base stations are used to provide total area coverage. However, in order to optimally utilise the radio spectrum it is desirable to reuse the frequency channels. Frequency reuse concept [8] when applied, permits the system to meet the important objective of serving a large area, while using a relatively small frequency spectrum.

Frequency reuse refers to the use of radio channels on the same carrier frequency to cover different areas separated from one another by sufficient distance. The frequency reuse concept can drastically increase the spectrum efficiency but if the network is not designed properly serious interferences may cause poor quality performance. It is usually a requirement that a service area be protected from interference for a high percentage of time, figure of 90% is being in use in mobile communication network.

The required ratio of the desired signal level to undesired signal level is the key factor when designing a mobile radio communication network [5] planned on frequency reuse concept.

The interferences which are taken into consideration in the network planning are co-channel and adjacent channel interference. Improvement in receiver design can certainly reduce the effect of adjacent channel interference but co-channel interference can only be minimized by a good frequency plan.

Co-channel Interference : It is caused due to the reuse of the same carrier frequency at different geographical locations. The design requires that the desired signal level Pr should exceed atleast p times the undesired co-channel interference signal level Pc, in order to ensure that there is no co-channel interference. Thus we have:

$$Pr \geq p.Pc \qquad (2)$$

where p is the co-channel protection ratio and has the value greater than unity. The recommended value of S/I protection ratio p is meant to ensure a satisfactory reception in the presence of co-channel interference [8]. It follows that the area in which an active transmitter prevents the receivers from satisfactory processing of the desired signals is much larger than the service area of the same transmitter. The radius of this larger zone is called the co-channel interference radius Ri.

Adjacent Channel Interference : This is caused by adjacent cells operating on adjacent frequency channels. Strong signal on adjacent channels can cause cross talk and desensitization of the receiver. The frequency separation, though the least possible in a set of consecutive channels, requires that the undesired adjacent channel interference signal level Pa may be stronger than the desired signal level Pr, without producing any harmful interference. This means :

$$Pr \geq q.Pa \qquad (3)$$

Where q is the adjacent channel protection ratio and has the value less than unity. The adjacent channel interference radius Ra is determined by the adjacent channel protection ratio [8]. Usually the adjacent channel interference radius Ra is smaller than the service radius R.

5. NETWORK PLANNING

The cellular approach is the most advanced technique to provide total area coverage while using limited radio spectrum. The design is aimed at calculating minimum frequency reuse distance for optimum signal to noise ratio required to have satisfactory communication. [8].

The system is realised as a network of contiguous cells distributed in a regular fashion. Each cell is served by a base station, which covers the area upto and into that of adjacent cells without leaving any gap. A cell here signifies the area in which a particular base station is most likely to serve mobile subscribers. The size of the cell is determined by the number of subscribers expected to be served in that area, grade of service desired and the propagation characteristics.

Cell Parameters : Consider that the area covered with hexagonal cells have identical transmitters centred in each cell and are equipped with non directional antennas. The array of base station sites is then approximated by a lattice model with regular hexagonal geometry. Refer Fig. 1. A regular lattice is formed with elementary cells. Adjacent cells with non-repeated frequency channels constitute a cluster of cells. The frequencies assigned to each cell in a cluster are reused in different geographical locations for optimum spectrum utilisation.

Before establishing the geometrical relation between various network parameters it is essential to define the separation between adjacent cells and co-channel cells.

Cell Separation, S : Defined as closest spacing between any two adjacent cells.

Reuse Distance, D : Defined as closest spacing between two cells using the same carrier frequency.

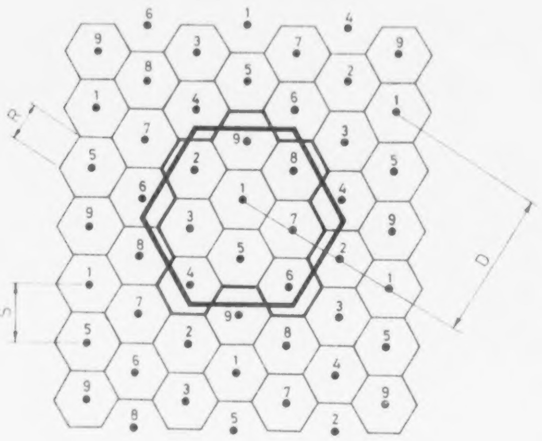


Fig. 1 : Network Parameters

The separation between adjacent cells is given by :

$$S = \sqrt{3}\, R \qquad (4)$$

Where R is the service radius and is equal to the side of the elementary hexagonal cell.

The area of one elementary hexagonal cell is :

$$a = 1/2. \sqrt{3}. S^2 \qquad (5)$$

If the cluster of cells is a closed group of N contiguous elementary hexagons, then full regularity of the lattice is obtained when N is given by the equation :

$$N = j^2 + k^2 + j.k \qquad (6)$$

Where j and k are positive integers or zero, and $j \geq k$. And N determines the size of a cluster.

Within the regular lattice, each cluster contains the same set of N cells. The cluster boundary formed by the sides of elementary hexagons when rectified also form a regular hexagon. The area of this hexagon is :

$$A = 1/2. \sqrt{3}. D^2 \qquad (7)$$

The area covered by one cluster composed of N cells must be equal to N times the area covered by one elementry hexagon.

Thus we have :

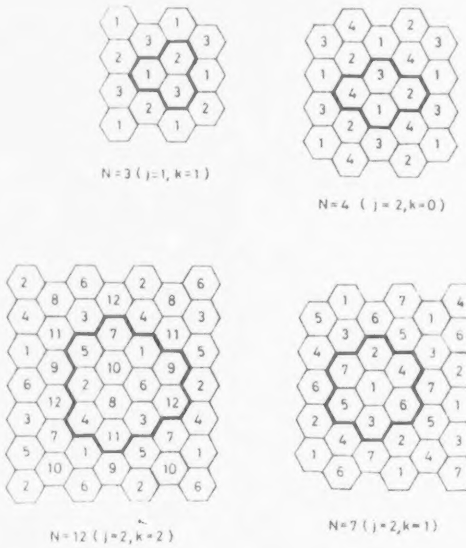
$$N.1/2. \sqrt{3}.S^2 = 1/2. \sqrt{3}. D^2 \qquad (8)$$

$$N = (D/S)^2 \qquad (9)$$

The equation defines how the cell parameters S and D are related to the spectral parameter N. This relation holds good for any regular lattice composed of hexagonal cells.

Frequency Assignment : The number of cells in a cluster determines the minimum number of channels required. N frequency channels per cluster results in assigning one channel to each cell. However, in actual practice, the traffic density and higher grade of service require assigning more than one channel to each cell. Considering uniform traffic distribution, the number of channels then required to provide total area coverage is given by n.N, where n is number of channels in each cell.

The assignment of channels in different cells of a cluster for various values of N as given by Equation (6) is depicted in Fig. 2. It is seen that typically in a 3 cell cluster each cell is adjacent to remaining two cells. In a 4 cell cluster two cells are adjacent to three cells each and the balance two



N=3 (j=1, k=1)

N=4 (j=2, k=0)

N=12 (j=2, k=2)

N=7 (j=2, k=1)

Fig. 2: Frequency Assignment

cells are adjacent to two cells each. Considering the 7 cell cluster, center cell is adjacent to the six cells and each cell in the outer ring is adjacent to three cells each. This implies that problem of adjacent channel interference is less critical in a 7 cell cluster as compared to 3 or 4 cell cluster. When $N \leq 9$, adjacent channels can not be avoided in a cluster. However, for a 12 cell cluster the problem of adjacent channel is completely avoided but this is at the cost of increase in reuse distance.

6. SPECTRUM OPTIMISATION

In a practical system the number of cells N per cluster is decided by area coverage and interference considerations. Theoretically a large value of N is desired so that the interference is minimum. However, this results in spectrum inefficiency. So in order to improve spectrum utilisation, it is desired to maximise frequency reuse. This requires bringing the cells using same frequencies as close together as possible. Which suggests aiming at a smaller value of N. But there are constraints imposed by co-channel and adjacent channel interference which restricts a designer from reducing the value of N.

The design for spectrum utilisation follows from the analysis of service radius as affected by radio propagation and the cell parameters as affected by the interference radii.

The co-channel separation distance is determined by relevant protection ratio and variation of signal strength with distance [10]. The frequency reuse requires that :

$$D \geq (R + Ri) \qquad (10)$$

This separation in space is necessary in order to meet the level separation requirements of co-channel interference. From equations (4),(9) and (10) we get :

$$S.\sqrt{N} \geq (R + Ri) \qquad (11)$$

$$\sqrt{N} \geq (R+Ri)/\sqrt{3}.R \qquad (12)$$

The minimum number of cells which would ensure compatible frequency reuse would be :

$$Nmin = (R+Ri)^2 / 3R^2 \qquad (13)$$

The value of Nmin determines the minimum number of cells in a cluster which has no overlap and use different frequency channels.

The adjacent channel separation depends upon its protection ratio as well as the geometry of the network. This implies :

$$S \geq (R + Ra) \qquad (14)$$

Corresponding to the minimum value of S, we have :

$$Nopt = (R+Ri)^2 / (R+Ra)^2 \qquad (15)$$

This gives the theoretical minimum number of cells allowing overlaps of the adjacent cells to the extent that there is no adjacent channel interference. The actual selection of optimum value of N for a regular lattice network is usually the smallest admissible value of N, as determined from equation (6), exceeding Nopt as given by equation (15).

From equation (12) and (15) we have a range of value of N.

$$(R+Ri)^2/3R^2 \leq N \leq (R+Ri)^2/(R+Ra)^2 \qquad (16)$$

It shows that minimum number of channels are defined by the propagation considerations and the protection ratios.

It is obvious that larger the cluster size, the fewer channels are available in each individual cell to service the required traffic. On the other hand, if the cluster size is small, large number of channels can be assigned to each individual cell in the cluster. But this results in smaller reuse distance which may result in incompatibility due to presence of co-channel and adjacent channel interference.

7. CONCLUSION

Normally for a regular lattice, minimum value of N provides optimum spectrum occupancy. In order to obtain best use of the spectrum it is desirable to avoid unnecessary coverage overlaps between adjacent cells. However, in actual design, the displacement of cells can not follow the regular lattice model. In that case a value of N between Nmin and Nopt determines the number of channels acceptable in the design. For the design to satisfy the reuse distance, actual Dmin should comply with the co-channel separation requirement. No adjacent channel should be assigned for $N \geq 12$, the design then automatically satisfies the adjacent channel separation requirements. However for $N < 12$ checking of adjacent channel separation is necessary.

8. REFERENCES

1. Arnaud J.F., "Frequency Planning in Europe", Proc. IEEE, Vol 68, No.12, (Dec.1980), 1515-1522.

2. Cooper G.R., Nettleton R.W., "A Spread Spectrum Technique for High Capacity Mobile Communications," IEEE Trans. On Vehicular Technology, VT-27, 4(Nov. 1978), 264-275.

3. Durkin J., "Computer Prediction of Service Areas for VHF and UHF Land Mobile Radio Services", IEEE Trans. on Vehicular Technology, VT-26, 4 (Nov. 1977), 323-327.

4. Edwards R., Durkin J., Martin R.E., "Computer Prediction of Service Areas for VHF Mobile Radio Networks", Proceedings IEE (London), Vol-116, No.9 (1969), 1493-1500.

5. Firestone W.L., "A Review of Communication Interference Problems", IEEE Trans. On Vehicular Technology, VT-14, (Mar. 1965), 57-65.

6. Henry J. Meyerhoff, "Network Planning and Spectrum Efficiency," Proc. Cellular and Mobile Communications International Conference, London, (Nov.1985), 125-137.

7. Hunt K.J., "Planning for Radio Broadcasting Services", J.IERE, Supplement to Vol. 58, No. 4 (June 1988), S55 - S64.

8. MacDonald V.H., "The Cellular Concept", Bell System Technical Journal 58, (Jan.1979), 15-42.

9. Oetting J.D., "A Comparison of Modulation Techniques for Digital Radio", IEEE Trans. on Communication, COM-27, No. 12(1979), 1752-1762.

10. Parson J.D., Propagation and Interference in Cellular Radio Systems", IEE Conference Publications 238, (Sept.1984), 71-75.

REGARDING THE TOPOLOGY DESIGN OF PRIVATE PACKET NETWORK SYSTEM

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ABSTRACT

We have constructed a network system using leased lines (high-speed digital lines) and public lines (ISDN). This network system is based on the concept that "the capacity of inter-node lines should be changed dynamically according to dynamic variation of traffic."
This paper describes the new concept and design method of such 'hybrid networks.'

1. INTRODUCTION

Conventional networks use leased lines (high-speed digital lines) in the basic network and public lines/low speed leased lines in the branch network, which is designed by based on a concept of "fixcapacity for lines."
Meanwhile, in Japan, when the Nippon Telegraph and Telephone Corporation (NTT) started an ISDN service in 1988, constructing a large-capacity communication network is become possible by using ISDN. Since ISDN appear, we have believed that it is no problem to transmit the capacity dynamically by combining the leased lines (high-speed digital lines) and public lines (ISDN) in the basic network. We have constructed a very useful network system in economy and functionality, based on the concept that "the capacity of inter-node lines should be changed dynamically according to dynamic variation of traffic."
In this paper, we describe the new functions and a concept also the design method of 'hybrid network' which is suited for data communication.

2. OVERVIEW

We have been integrating multi-media such as data communication, voice communication, and video communication. We have also defined 'hybrid network systems,' in which new technologies such as ISDN and satellite communication are merged.
Most recently we have designed the dynamic control of inter-node lines in data communication as the first phase of the dynamic control of hybrid network systems.

2.1 OUTLINE OF HYBRID NETWORK SYSTEMS

Currently we hybrid network systems consist of data communication (packet switching) units and voice communication (circuit switching) units. (See Figure 2.1)

2.2 ADVANTAGES OF HYBRID NETWORK SYSTEMS

1) Economy
   -Cost benefit obtained by absorbing the variation of traffic in leased and public lines
   -Cost benefit obtained by having integrated data communication and voice communication on one physical line
   -Efficiency of packet multiplexed transmission
2) Reliability
   -Construction of mesh networks from various media
3) Safety
   -Diffusion of failures by joint use of various media
4) Flexibility
   -Ease of changing in system to accomodate an increase or decrease of terminals
5) Uniformity
   -Dynamic throughput according to variation in traffic
6) Operability
   -Systems that match the centralized supervision of networks

3. NEW CONCEPT FOR NETWORK SYSTEMS

3.1 NEW CONCEPT

The network components are roughly divided into 'nodes' and 'lines.'(See Figure 3.1) The capacity of conventional inter-node lines is fixed. Network traffic, however, is not generally fixed but, in fact, varies dynamically. Hybrid networks are based on the concept that "the capacity of inter-node lines should be changed dynamically according to dynamic variation of traffic."
We have focused on packet switching as the first phase of implementing this concept. As a result, we have designed a hybrid network that uses leased and public switched lines in its data communication network.

More specifically, we have achieved a very high economical and reliabile network by assigning constant traffic to leased lines and peak traffic to public switched lines. This concept can be used not only for data communication, but also in the line design of multi-media network systems including voice and image systems.

3.2 NEW DESIGN POLICY

We have applied the following 'Design Policy' to the hybrid network design.

1) Concept of peak traffic
==> Pursuit of economy
In conventional network design, leased lines having enough capacity to cover peak traffic were set up as inter-node lines. The hybrid network, hovever, can absorb the differences between the peak and constant traffic in the public switched line. (See Figure 3.2)

2) Backup path ==> Ensuring reliability
In conventional networks, reliability is improved by using a mesh configuration in which leased lines are used as the alternative circuits. In hybrid networks, public switched lines can be used as the alternative circuits. When backup requests are generated in the network, new routes that use public switched lines are set up dynamically. (See Figure 3.3)

3.3 MODELING NETWORK TOPOLOGY

Conventional network topologies include star, tree, and mesh types. In the past, the topology is only designed by combining these types, which is static topology design.
In hybrid network system, based on the function of changing line capacity dynamically and set up new routes dynamically, dynamic design of topology is become possible. (See Figure 3.4/3.5)

3.4 NEW TECHNICAL FACTORS

For the models have described above, for the additional of new technical factors are described below:

① Delay of connecting path on public line (ISDN)
-The store and forward function of packet switching is utilized so that the end-to-end communication path may be hold while there is the delay of connecting path on public line(ISDN).

② Recognition of establishing and clearing the path on public line(ISDN)
-The function module of line error detection and congestion control recognizes establishing and clearing the path on public line(ISDN).

③ Total system tuning
-Tuning of various parameters including for the end systems connected to the network may hold the communication path of the end systems.

4. CONCLUSION

We have developed an approach to the planning and design of networks based on the concept that "the quality of network management determines the value of large-scale network systems."

We believe, the dynamic control of network systems to be of great significance in the use of system resources.

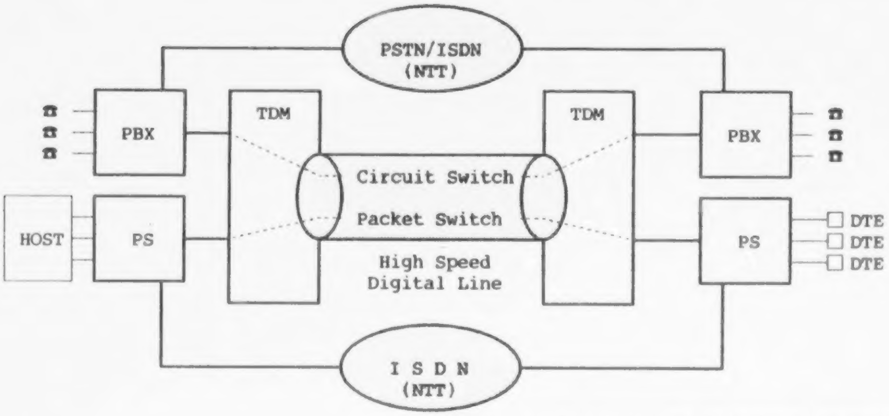
To validate the above, we have now performed dynamic use of links by applying packet-switching and the existing functions and technology of leased and public switched lines to hybrid network systems.

This concept will allow multiple media including data communication, to dynamically use one physical line. We will also apply the concept to other media.

REFERENCES

1) Makoto KAWASHIMA, "CABIN NETWORK SYSTEM," FUJITSU Journal, Vol.13, No.7, 1987.

2) Makoto KAWASHIMA, et al., "NETWORK MANAGEMENT OF LARGE-SCALE NETWORKS," PTC'90, 1990.


PSTN/ISDN
(NTT)
☎
☎
☎
PBX
TDM
TDM
PBX
☎
☎
☎
Circuit Switch
Packet Switch
HOST
PS
PS
DTE
DTE
DTE
High Speed
Digital Line
I S D N
(NTT)

PSTN : Public Switched Telephone Network
PBX : Private Branch Exchange
PS : Packet Switch
TDM : Time Division Multiplexer
ISDN : Integrated Services Digital Network

Figure 2.1 Hybrid Network Systems

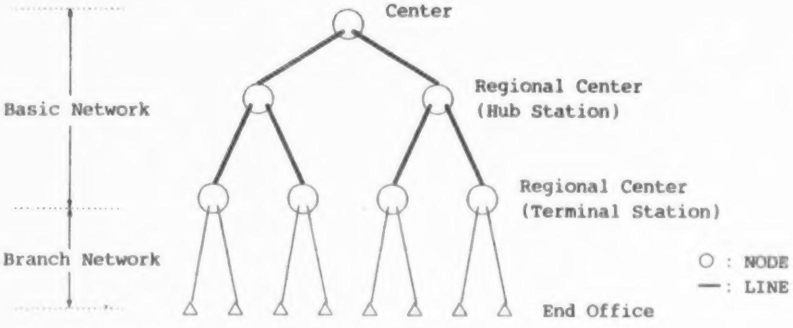

Center
Basic Network
Regional Center
(Hub Station)
Regional Center
(Terminal Station)
Branch Network
○ : NODE
—: LINE
End Office

Figure 3.1 Hierarchical Structure of Network System

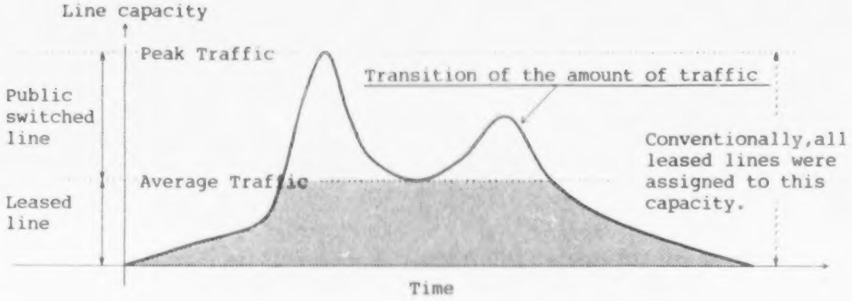


Figure 3.2 Concept of line assignment in hybrid networks

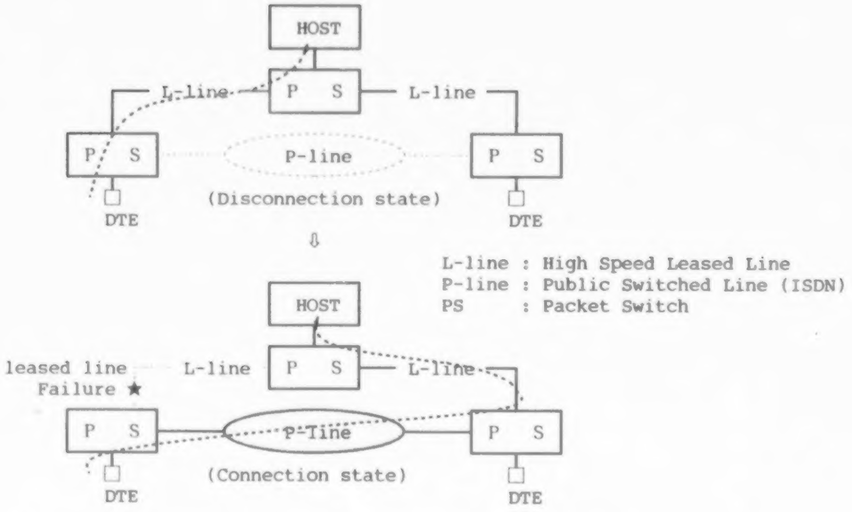
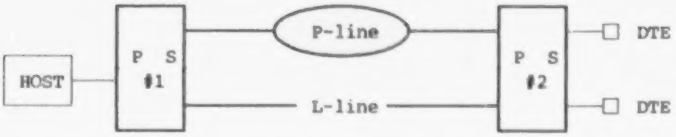
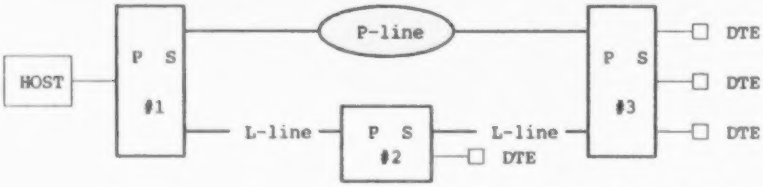

HOST
L-line
P S
L-line
P S
P-line
P S
(Disconnection state)
DTE
DTE
L-line : High Speed Leased Line
P-line : Public Switched Line (ISDN)
PS : Packet Switch
HOST
leased line Failure ★
L-line
P S
L-line
P S
P-line
P S
(Connection state)
DTE
DTE

Figure 3.3 Setting up dynamic routes in hybrid networks


HOST
P S
#1
P-line
L-line
P S
#2
DTE
DTE

P-line : Public Switched Line (ISDN)
L-line : High Speed Leased Line

Figure 3.4 Modelling of the network topology (Pattern-1)


HOST
P S
#1
P-line
L-line
P S
#2
DTE
L-line
P S
#3
DTE
DTE
DTE

P-line : Public Switched Line (ISDN)
L-line : High Speed Leased Line

Figure 3.5 Modelling of the network topology (Pattern-2)

Use of Small Digital Exchanges
for
Congestion Relief in Urban Networks

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1. ABSTRACT

This paper proposes a pragmatic approach to introducing digital switching in developing countries. Small stand-alone digital exchanges are used for initial congestion relief in the urban network, with subsequent relocation to rural or suburban locations. The main advantages are rapid implementation, economic viability, and management and marketing credibility. A successful case study is presented and switch performance requirements are outlined.

1.0 INTRODUCTION

This paper describes the use of small digital telephone exchanges as a first step in relieving congestion in critical areas. The exchanges may be later moved to rural areas or provincial towns for regular service. This approach also provides a possible solution to the dilemma of developing an investment case for the rural exchange which is required for policy reasons.

This paper is based on experience and the known requirements of countries in Africa, Latin America, and the Asia-Pacific region. Although each network situation is unique in itself, we can draw some meaningful generalizations as to the type of situation which best lends itself to this solution.

2.0 TYPICAL NETWORK SCENERIO

Congestion problems often result from a prolonged period of minimal investment due to foreign exchange shortages, or from a rapid expansion of demand in an economic boom, which temporarily outstrips the investment capability of the telephone administration.

This can result in a long waiting list, problems in grade of service, trunk congestion, and eventually a loss of credibility with the public which may lead to calls for regulatory or policy action.

3.0 OBJECTIVES

3.1 MARKETING OBJECTIVES

It is desirable to formulate an action plan with the objectives of improving the image of the Administration, improving quality of service, and recapturing lost revenue. This can be done by concentrating on a short-term solution to provide improved service to key subscribers and visibly attacking the waiting list in a tangible way.

3.2 STRATEGIC OBJECTIVES

It is not necessary to trade off the effectiveness of longer term, larger scale programs already committed in order to begin to accomplish this. In fact the positive results can support strategic objectives by establishing planning baselines for these larger undertakings.

Rural programs provide an example of strategic programs which can be greatly assisted by the urban congestion relief program. In the urban network, the small exchange will typically pay for itself in a matter of months. This provides a very straightforward investment case.

The exchange can be designated for its ultimate destination in the rural network, and possibly even funded from concessional rural finance programs. This is highly appropriate because funds are available for these programs but there are difficulties in formulating financially viable programs because of demand uncertainty. Temporary installation in an urban setting provides a means of breaking out of this dilemma.

Other strategic objectives supported by a congestion relief program are the possibility of responding more effectively to a competitive environment. A small initial investment and rapid response capability will better equip the operator to respond to the needs of key clients before, during, and after competition is established.

A congestion relief program using modern small digital exchanges also allows the early introduction of digital service as well as value-added services which will generate enhanced revenue from the existing subscriber base.

3.3 IMPLEMENTATION OBJECTIVES

The modern small digital exchange allows for simple and rapid execution of the congestion relief program, minimizing demands on planning, operations, and maintenance staff.

Investment is incremental with a very fast recovery of investment. Cost impact is minimized because existing buildings can be utilized. The compact size of the exchange allows it to be installed with out removing existing exchanges, minimizing cost and disruption. The incremental expansion results in a more gradual investment in cable plant, power, etc., again permitting effective cost control.

3.4 HUMAN RESOURCES DEVELOPMENT

The approach described herein also allows the planning and operational staff to acquire early experience with digital equipment and new features such as itemized billing. Training on small exchanges is a good introduction to such topics as network traffic management, maintenance strategies, and value-added services.

4.0 SITE SELECTION CRITERIA

Sites under consideration should have strategic economic importance for the operating organization. They could be nearing or past saturation of exchange connections. One should also look for a reasonably good situation on exchange connections and interconnection by junction cables, in order to maximize the impact of our investment.

Spare local line plant capacity is often available in cases where exchange congestion is the main problem. It is desirable that the exchange terminate more than one junction route to take advantage of the digital exchange's strong tandem switching ability and automatic alternate routing for better trunk utilization.

The exchange may already be slated for a larger exchange or even be partway though procurement. Surprisingly this may be a very positive indication to consider short-term congestion relief with a small digital exchange, since revenue can be recovered in perhaps one year while paying for the small exchange. This revenue would otherwise be totally lost to the Administration. Also, the marketing case is already established, allowing one to move speedily to approve a small short-term investment.

5.0 CASE STUDY

5.1 SITE SURVEYS

The illustrations show a case study for an actual situation. A preliminary survey (fig 1) showed the site labelled "industrial 1" to be the main problem. An 1800-line step-by-step exchange was past saturation, with 2000 potential subscribers waiting for service. This exchange handles 40% of the PTT revenue from the city. The PTT was largely reliant on aid funds which were very scarce.

A second stage survey (fig 2) revealed that the site was actually "tromboned" to a larger exchange labelled "Central". There were many trunks but they were poorly utilized since trunks were seized each time a subscriber went off hook. There were also low-capacity microwave links which were leased out to airport subscribers as a temporary expedient to serving a new exchange area where international trade fairs are held.

5.2 FIRST STAGE OVERLAY

After considering various possibilities, it was decided to start with two 500-line digital increments for the sites labelled "Industrial 1" and "Airport" (fig 3). Existing exchanges were retained and renovated at minimal cost. The reasons for this were the following:

a) Line plant capacity already available

b) No building enhancement required.

c) This was seen as a first step to a grid or mesh network permitting automatic alternate routing of airport traffic to industrial sites based on peak traffic times (e.g. international flight arrivals). This architecture also allowed the exchanges to compensate somewhat in the first months for trunk cable problems during rainy season. It was however recognized that trunk rehabilitation and if possible replacement was a high priority to get full benefit from the exchange improvements.

d) Utilization of trunks to "Central" would be greatly improved giving better service from the industrial parks to the downtown.

e) The sites met the criteria for strategic economic importance. It was calculated by the Administration that the investment in the small exchanges would be recovered in three months.

5.3 SECOND STAGE OVERLAY

In the second stage (fig 4) the first

two digital exchanges will be expanded and two additional exchanges added as adjuncts to the "Industrial 2" and "Central" sites. This will eliminate the current waiting list at four sites. The existing microwave could be used to complete a full mesh network of four digital exchanges using existing transmission facilities and existing buildings. It is also intended to install fibre trunks at about the same time.

Near "Industrial 2" a new exchange is planned for the future. The digital exchange permits a sub-group of subscribers from the expansion area to be allocated a separate exchange prefix so that they can retain their subscriber numbers in the future when an exchange is provided in a new building in the expansion zone.

5.4 MEDIUM TERM GROWTH

The exchange can grow in smooth increments to 5000 subscribers. This allows a medium-term scenario (fig 5) to eliminate all of the old exchanges and establish full digital service in the service area.

By this point the credibility of the modernization program should be firmly established and it should be possible to finalize major exchange expansion activities which have been in planning for some years.

5.5 LONG TERM GROWTH

In the long term (fig 6) two of the small exchanges (Airport and Industrial 2) should be adequate for the suburbs they serve, so they can remain as a more reliable alternative to a remote concentrator.

The exchanges at "Industrial 1" and "Central" will most likely move to rural sites or provincial towns depending on the level to which they have first been expanded. Larger urban exchanges would by then be installed at these sites. This will be facilitated by the availability of space as a result of replacing the electro-mechanical exchanges, and by the provision of optical fibre trunks. The automated billing system will also have been fully established.

6.0 EXCHANGE REQUIREMENTS

In order to support the congestion relief scenario described here, a small digital exchange must have a number of attributes to allow it to function in both the rural and urban environments. These include:

a) Small floor space requirements to allow it to be installed without removing existing switching equipment.

b) Ease of installation, expansion, and relocation.

c) Environmental robustness.

d) High reliability and very good maintainability.

e) Modest power consumption and available power back-up. (A power equipment rack can form part of the switching line-up, provided it uses sealed cells to allow it to be co-located with the exchange.

f) Various billing systems including bulk and itemized billing.

g) Inter-working with electro-mechanical exchanges for billing, etc.

h) Programmable class of service assignment to minimize problems in introducing new services.

i) Custom calling features for key clients in urban and remote (e.g agricultural or mineral extraction) areas.

j) Tandem as well as local capability is required to effect the congestion relief.

k) A variety of analog and digital trunk interfaces and their variants must be supported. These must be readily re-programmable in the field when the exchange is moved.

7.0 CONCLUSION

7.1 ECONCOMIC BENEFITS

This approach allows for low initial investment with maximum impact. It allows for both urban and rural priorities to be addressed and facilitates finance. A short break-even time (frequently less than one year) is feasible.

An immediate increment in revenues is expected, limited only by the speed with which billing administration can be established for the new subscribers. This will include a foreign exchange component because of the subscribers who will make more international calls.

7.2 STRATEGIC BENEFITS

The recommended approach provides an immediate improvement in the credibility of the operating organization. It shows a high level of responsiveness to key customers while increasing revenue in the short term.

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The financial transition to larger exchanges is eased by reducing or eliminating the "revenue gap" which often happens in large procurements when interest is accumulating on purchased equipment which has not been fully brought into service. Exchange investment can be kept in step with line plant improvement programs.

Digital service is provided to key subscribers who might otherwise consider alternatives such as private networks, competing carriers, etc.

A tangible improvement in overall network management results from the capability of the small digital transit exchange to monitor trunk traffic. this provides data which is highly useful in managing the network in the short run as well as in long-term network planning.

The network created with this approach is more survivable than one based on a host-remote architecture. Alternate routing makes the network more efficient as well. A distributed network of smaller stand-alone exchanges allows the investment to go into exchange capacity rather than buildings and reduces the cost and length of local subscriber connections.

The small exchange program is complementary to a large urban exchange program for the downtown core in that it establishes the market and traffic patterns and the network feasibility along with the business case.

A final advantage is that the same equipment is used for urban and rural switching, allowing for more cost-effective sparing, training, support, and flexible deployment of network resources.

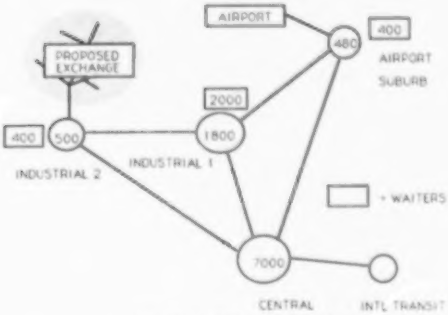
AIRPORT
400
480
AIRPORT SUBURB
PROPOSED EXCHANGE
2000
400
500
1800
INDUSTRIAL 2
INDUSTRIAL 1
= WAITERS
7000
CENTRAL
INTL TRANSIT

FIGURE 1 - PRELIMINARY SURVEY

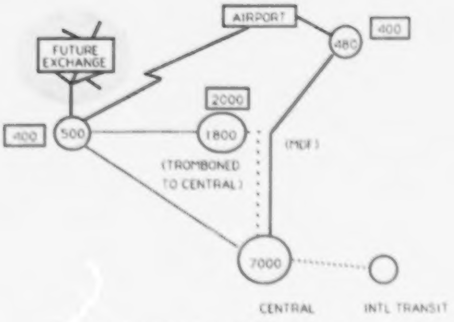
AIRPORT
400
480
FUTURE EXCHANGE
2000
400
500
1800
(MDF)
(TROMBONED TO CENTRAL)
7000
CENTRAL
INTL TRANSIT

FIGURE 2 - SECOND STAGE SURVEY

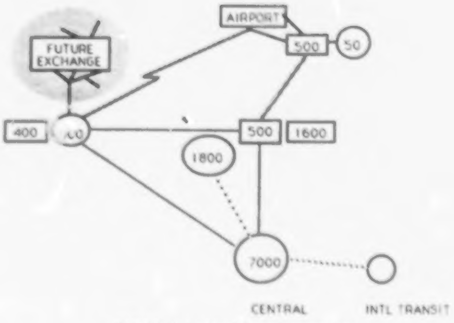
AIRPORT
FUTURE EXCHANGE
500
50
400
500
1600
1800
7000
CENTRAL
INTL TRANSIT

FIGURE 3 - FIRST STAGE OVERLAY

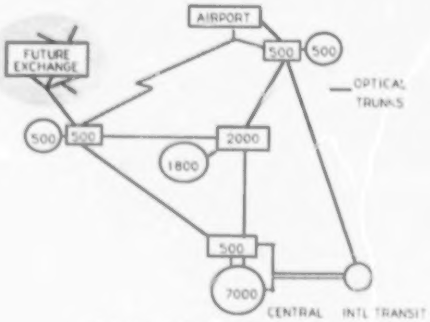
AIRPORT
FUTURE EXCHANGE
500
500
OPTICAL TRUNKS
500
500
2000
1800
500
7000
CENTRAL
INTL TRANSIT

FIGURE 4 - SECOND STAGE OVERLAY

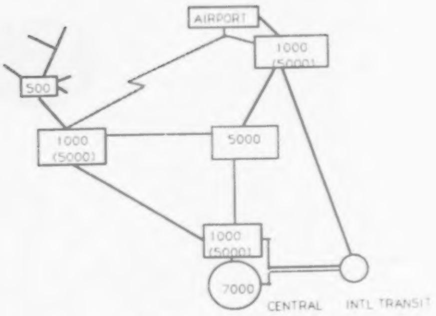
AIRPORT
1000 (5000)
500
1000 (5000)
5000
1000 (5000)
7000
CENTRAL
INTL TRANSIT

FIGURE 5 - MEDIUM TERM GROWTH

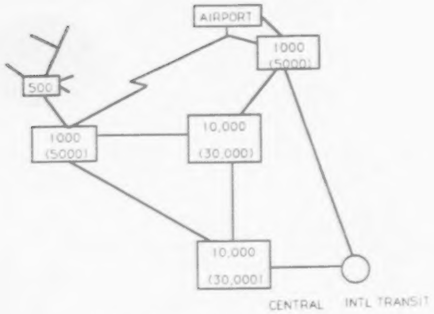
AIRPORT
1000 (5000)
500
1000 (5000)
10,000 (30,000)
10,000 (30,000)
CENTRAL
INTL TRANSIT

FIGURE 6 - LONG TERM GROWTH

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TOWARD MORE RELIABLE TRANSPACIFIC TELECOMMUNICATIONS

David Martin
Vice President, Program and Business Development
Pacific Telecom Cable, Inc.

1. ABSTRACT

Telecommunications users' insistence on reliability and diverse routing is being met through a combination of an increasing number of transoceanic fiber and satellite links and the establishment by carriers of comprehensive restoration and cable maintenance procedures. This presentation describes present and future programs for trans-Pacific service.

Honolulu, January 1991

A growing network of satellite and fiber optic cable links serving the Pacific Rim is enhancing telecommunications capabilities for the region. Over the long term users will enjoy more reliability because more facilities mean more assurances of service continuity through diverse routing and restoration.

But for the near term, the concern is that along with the growth in facilities has come the need for the carriers to more fully define restoration and maintenance procedures. For the purposes of our presentation today, restoration means timely rerouting of traffic on alternate transmission facilities. Maintenance procedures relate to the repair of submarine fiber optic cable systems. Today's overview will bring you up to date on what exists and what is being proposed to provide more reliable trans-Pacific service.

2. A LOOK AT THE FACILITIES

We'll start by looking at the transmission facilities serving the region. With the emergence of Pacific Rim countries as major players in the international marketplace, great emphasis has been placed on the need to establish a comprehensive restoration plan that could be implemented expeditiously in the event of a cable failure. The need for such planning is especially critical given the limited number of trans- Pacific links as compared with the Atlantic.

Indeed, the rapid growth of the Pacific Rim as a commercial center has until recently outpaced the provision of telecom capacity to serve the area. Until 1989, only two analog cables -- TPC-1 and TPC-2 -- connected the U.S. and the Far East, while a third, ANZCAN, stretched from Canada through Hawaii to New Zealand and Australia. Satellite service was provided by the 174°E and 183°E Pacific Ocean Region Intelsat spacecraft. Sufficient overall capacity existed on these facilities to provide service protection/restoration until recently, when traffic growth and large-capacity submarine fiber optic cables have significantly changed the picture.

With the turnup of the HAW-4/TPC-3 cable in 1989 and the scheduled activation of the North Pacific Cable (NPC) next month, trans-Pacific voice-grade circuit capacity has exhibited dramatic growth.

As these new cables approach full utilization, there will be insufficient unutilized transmission capacity in the Pacific to provide 100 percent restoration in the event of a cable failure. This is because there is insufficient satellite capacity for full cable restoration purposes. Similarly, until other Pacific fiber systems are commissioned, fiber-on-fiber restoration capability will not be available.

On the plus side is the inherent reliability of fiber and the forward planning of the region's carriers.

3. SERVICE RESTORATION

Overall facilities planning for service restoration in the Pacific is under the direction of the Pacific and Indian Ocean Restoration Committee (PIRC). This committee, comprised of representatives of all carriers serving the region, regularly meets to plan the mechanics of service restoration.

Several scenarios have been developed to address the restoration question. One relates to using cable capacity -- either unallocated, or allocated but not in use -- to provide fiber-on-fiber restoration. This forms the heart of the trans-Pacific mutual aid program advanced by the owners of NPC. Under this proposal, each party to the agreement would provide restoration of an agreed number of 45 Mbit/s traffic streams over the submerged portion of the respective cables, that is, cable station to cable station.

Because the NPC, HAW-4/TPC-3 and TPC-4 trans-Pacific cables land at different locations, discussions are being held relative to the provision of the required interconnects on either end. For example, interconnects on the Japan end of trans-Pacific cables would be via the repeaterless submarine MCC cable being constructed by International Digital Communications (IDC) to connect the Miura landing station of NPC with the Chikura landing stations of the TPC-3 and upcoming TPC-4 cables.

On the U.S. end, interconnects between the Pacific City landing station of NPC and the Point Arena landing station of HAW-4 would be via a fiber link between the cable gateways at Portland and Sacramento, respectively. Restoration of the trans-Pacific cables will also restore transit traffic routed to points beyond Japan via the APC cable landing at Miura and the Hong Kong-Japan-Korea (HJK) cable landing at Chikura.

A similar Mutual Aid program is being proposed by the owners of the Hong Kong Taiwan-2 (HONTAI-2) system for the HONTAI-2, HJK, TPC-3 and GPT cable systems which form a self-healing fiber ring serving Hong Kong, Japan, Guam and Taiwan.

It is evident from the activation dates of the major trans-Pacific facilities that the cable systems are ideally suited for mutual aid. TPC-3 is operational and NPC is due to be activated next month. TPC-4 is scheduled for 1992 and the PacRim-Tasman-2 system is scheduled for 1994. This means that as one system is being loaded, thereby reducing the capacity available for restoration, another system, with some of its capacity initially inactive, becomes available. The objective would be for fiber-on-fiber as the primary restoration routing.

4. FURTHER OPPORTUNITIES

With a view toward further cost effectiveness in the development of Pacific restoration plans, the PIRC has agreed that restoration transponders on satellites be shared between cable owners. Shared facilities make sense from an economic viewpoint if a satisfactory cost-sharing arrangement can be negotiated. They also make sense from a practical viewpoint because of the low probability of two cables experiencing simultaneous failure.

As a result of this transponder sharing proposal, a Multiple Cable Contract Pool is being developed. The pool would be comprised of restoration transponders reserved by owners of each of the major trans-Pacific cables.

Initially the pool would include nine 36 MHz transponder pairs, the total restoration capacity of the 177°E satellite. Each 36 MHz transponder pair is capable of restoring one, one-way 45 Mbit/s traffic stream. The number of restoration transponders will increase with the planned move of all satellite restoration services to the 183°E satellite.

This combination of cable system mutual aid arrangements and satellite system transponder sharing will effectively accommodate trans-Pacific cable restoration requirements for the foreseeable future. Since most administrations own capacity in all four trans-Pacific fiber systems, everyone stands to benefit. By cooperating with each other, cable owners should more readily achieve the common goal of providing all users with continuity of service in the most efficient and cost-effective manner.

5. CABLE MAINTENANCE

Our final consideration today for more reliable transpacific telecommunications focuses on the maintenance of submarine fiber systems.

Maintaining submarine cable systems has a long and colorful history -- dating from Cyrus Field's 13-year endeavor to span the Atlantic with a telegraph line some 125 years ago. He experienced the same challenges system operators face today to provide service continuity against a combination of external and internal causes of failure.

External influences include damage or breaks from seismic activity, fishing and trawling, from mud or rock slides and even from shark bites. Trans-Pacific links cross regions of high tectonic activity, and plunge into some of the deepest waters in the world. NPC, for example, reaches a depth of 24,600 feet -- nearly five miles -- in the Japan Trench. While the Atlantic may be a more benign environment geologically, we're well aware of the many cable failures due to fishing and trawling activity, especially in the North Sea region where multiple cable breaks in a single year are not uncommon.

Other than cable breaks, component failure, insulation failure, fiber degradation and chafing are chief concerns.

Cable system operators endeavor to guard against cable breaks through armoring and burial in shallow waters, by careful route selection, by using lightweight screened cable in deeper regions and by close cooperation with local fishing operations. Continuing efforts are also directed toward the development of more reliable deep-sea system components.

Nevertheless, cableship maintenance services are a necessary component for undersea cable operations. Maintenance services are provided by the principal cable owners through employing cable repair ships, shore-based equipment depots and remote controlled submersible vehicles (RCSV).

The primary cable maintenance facility is the cableship, which is tasked with locating, recovering, repairing and replacing submarine cable systems in both deep and shallow water. The depot, ideally located adjacent to the cableship's base port, contains cable spare parts matching those employed in the system along with other components and equipment necessary for the repair operation such as jointing and test equipment.

The RCSV, which is normally tethered to and controlled from the cableship, is used to locate, recover, cut, replace and rebury sections of buried cable.

6. AVAILABLE CABLESHIPS

In the Pacific, transoceanic undersea cables traditionally have been protected under Cableship Maintenance Agreements that have been established by a few large companies such as KDD, AT&T and Cable and Wireless (Marine). The Pacific Ocean is currently divided into zones with ships based in Hawaii (AT&T); Yokohama (KDD), Fiji (C&W [M]) and Singapore/Philippines (C&W [M]).

The cableship serving the Hawaii Agreement is AT&T's Charles L. Brown, which is responsible for 15,000 nautical miles of cable. AT&T is constructing two new cableships in a Singapore shipyard. One of these will be based on the Northwest coast of the United States for service on cables in the Northeast Pacific, including TPC-4.

The ship serving cables covered by the Yokohama Agreement is the KDD Maru, which currently maintains 15,000 nautical miles of cable. KDD has announced plans for a new cableship. C&W (Marine) operates from Fiji the Pacific Guardian to maintain 9,000 nautical miles of cable in the Southern Pacific and two ships for the Southeast Asia - Indian Ocean region. These are the Enterprise based in Manila and the Retriever based in Singapore that together oversee 19,000 nautical miles of cable.

In addition, NTT International in Japan operates a fleet of four ships to maintain their system of more than 700 individual domestic cable links serving the Japanese islands. The largest of these ships is the Kuroshio Maru, a standard-sized deep oceangoing cableship that was used to install a portion of the North Pacific Cable.

7. THE NEED FOR ADDITIONAL COVERAGE

While existing and planned cables travel across the Pacific Ocean, NPC will be the first cable to transit the North Pacific Ocean. This is a region of severe weather and turbulent seas, particularly during the winter months. In October 1990, for example, during the installation program for the Alaska spur of NPC, one of the cableships experienced winds to 60 knots and waves to 70 feet. These conditions were caused by a low pressure system associated with a frontal trough. NPC's owners need to feel confident that cableships adequately designed to operate in the severe weather conditions of the Northern Pacific are available 100 percent of the time for repair and maintenance activity.

The dual requirement of withstanding severe weather and maintaining close to 100 percent availability, together with several other factors, led the NPC Founding Signatories to announce in September 1990 a plan to establish a joint venture cableship company. The company would own and operate a cableship to be utilized primarily for repair and maintenance of the U.S. end of NPC.

This cableship could also be used for repair and maintenance activities for other cables in the Pacific Ocean, thus increasing the availability of cableships and enhancing the reliability and availability of undersea cable systems used throughout the Pacific Rim.

8. IN CONCLUSION

Four factors are combining to provide more reliable telecommunications services for the Pacific Ocean region and the world at large. They are the growth in the number of trans-Pacific telecommunications systems, cable mutual aid programs for restoration, the participation of carriers in satellite transponder sharing, and additional cableships for maintenance and repair.

HAWAII'S LEGISLATIVE ACCESS EXPERIENCE

Representative Carol Fukunaga
Representative David Ige
Representative Les Ihara, Jr.
Gail Iseri

Hawaii State House of Representatives
Honolulu, Hawaii, USA

In view of emerging telecommunication technologies and Hawaii's central location in the Pacific, the Hawaii State Legislature has taken bold steps in establishing policies and directions to establish the State as the "Information Hub of the Pacific." This paper discusses the Legislature's recognition of the potential of telecommunications and high technology to stimulate economic opportunities, increase access to government information, and improve public services. Also discussed are the legislative initiatives that were established to make our vision a reality which include providing for a statewide information network and becoming the first information provider on that network with its *ACCESS* service.

1. Introduction

With the dawning of the Information Revolution, the union of the personal computer and the telephone network is proving to be as important to the people of Hawaii as the Gutenburg press has been for the world for the past two centuries. The Hawaii State Legislature recognizes the opportunities offered by technology and telecommunications and has taken bold steps in establishing policies and directions to provide Hawaii's residents access to a far reaching "global network." Our vision is to establish the State as the "Information Hub of the Pacific."

In addition, the Hawaii State Legislature has recognized the importance of telecommunications and information technologies to the State due to our island geography and relative physical isolation in the middle of the Pacific. We have initiated programs which utilize these sophisticated technologies to accomplish legislative objectives in three areas:

- Stimulate economic opportunities for high technology industries;
- Improve public access to government information; and
- Broaden the use of technology in providing efficient government services.

By setting these objectives, we have afforded Hawaii a secure place in tomorrow's high technology world as well as confidently assured its citizens of their continued democratic rights in the eminent Information Age.

As one of its primary steps in meeting these objectives, the Legislature enacted landmark legislation in 1988 to construct a state-of-the-art telecommunications network for the State, provide an information gateway, and stimulate the development of private information industries. In addition to this broad initiative involving many private businesses and government agencies, we initiated our own public access system, called "*ACCESS: Legislative Information System*," as an example of what could be accomplished utilizing the telecommunication infrastructure created by the 1988 legislation.

This paper briefly describes Hawaii's statewide information network established as a result of these efforts and focuses on how one system, *ACCESS*, provides a demonstration of the Legislature's goals.

2. Hawaii's Statewide Information Network

As part of the 1988 Legislative initiative, a statewide information network has been established to serve as the gateway for the public and private information providers to citizens of Hawaii. This information network allows a collection of information providers to disseminate information more efficiently and extensively than would otherwise be possible.

Hawaii's statewide information network utilizes state-of-the-art microwave and telecommunications technology to link each neighbor island and Oahu into a comprehensive network which will support:

- A gateway that gives users a single point of access into potentially hundreds of public and private information services;
- Provide user registration, billing, directories, and other gateway services;
- Videotex services for easy, interactive use with information services and other users;
- Provide access through VT100 and compatible terminals; Northern Telecom videotex terminals; microcomputers with VT100 emulation software; and microcomputers with videotex emulation software; and
- Toll-free dial-up service from neighbor islands.

In addition to the communications facilities, the Legislature has chartered the Hawaii Information Network Corporation (Hawaii, INC) to link private and public efforts to utilize the network technology. Hawaii INC's role in the initiative is to be a catalyst in the development of an information industry in the private sector, provide the means whereby the public will have a single point of access for timely and pertinent information from private and government agencies, and promoting the use of telecommunication and high technology to bring information services to all the citizens of the State.

With the statewide network's infrastructure in place, Hawaii is in an ideal position to meet the objectives set forth by the Legislature.

3. What Is *ACCESS*?

The Hawaii State Legislature's "*ACCESS: Legislative Information System*" is an excellent example of the potential of Hawaii's statewide information network. *ACCESS* is an on-line legislative information system which enables citizens to instantly review the text of bills, resolutions, committee reports, hearing notices, and legislative information in a timely manner. In addition to free statewide computer retrieval services, *ACCESS* also provides the public with a means to communicate with legislators and other citizens through ACCESS Net, an audio bill status system via touch tone telephone called AudioACCESS, and facsimilie projects.

A fairly new feature to *ACCESS* is ACCESS Net, an interactive electronic networking service which allows Hawaii residents to communicate with other residents, including legislators, on issues facing our State. Inquiries and suggestions about state issues can be sent directly and privately to legislators and other users using electronic mail. In addition, on-line discussions on a variety of issues of concern to the community can be carried on in the electronic conferences.

All components of *ACCESS* were designed to be utilized by both novice and sophisticated users. It provides information simple enough for young students to understand, but substantive enough for a seasoned follower of the Legislature to find useful. The statewide information network provides the infrastructure which allows the Hawaii State Legislature to provide timely, statewide access to this information.

Entry into *ACCESS* can be achieved in a number of ways using: (1) PC and modem; (2) public terminals at all 49 state public libraries; (3) public terminals at the Capitol Public Service Room; and (4) videotex terminals at all 232 public school libraries and in selected classes at seven public schools.

In addition to being the first information provider participating on the state's information network, *ACCESS* embodies the elements of the three objectives set forth by the Legislature which would:

- Broaden the use of technology in providing efficient government services;
- Improve public access to government information; and
- Stimulate economic opportunities for high technology industries.

4. Education, Economic Development, and Public Service Goals

The education, economic development, and public service goals of *ACCESS* directly support the goals of the overall initiative. As we set about our mission of improving public access, there was a realization that there was a broader mission to pursue, that of using technological advances and telecommunications to enhance the future of our State as a whole. Just as telecommunication developments have all but eliminated the obstacles of time and distance in traditional information dissemination methods to all sectors of society, from government to business to educational institutions to individuals, *ACCESS*, together with other information sources, will provide the same benefits to the State of Hawaii. With telecommunications serving as the building block, the legislative *ACCESS* system placed the cornerstones to the foundation for a better tomorrow for Hawaii. These cornerstones include: (1) opportunities for educating and training for the children and adults of the State; (2) encouraging and supporting economic development for Hawaii; and (3) providing better government services to residents.

In the area of educational opportunities, the Legislature firmly believes that the right of all citizens to be informed and to exchange ideas freely is a basic concept of democracy. This right would certainly extend to educating the public on how to obtain and use the information to their benefit. *ACCESS* has provided an obvious opportunity for adults and children to not only access legislative information, but to also learn about the Legislature and the legislative process from the Legislature directly. This will encourage the acquisition of information directly from originating agencies and dissuade dissemination of misinformation. The public will not have to rely on the media or word of mouth to obtain their information. The Legislature has established a statewide information network which will create a major "magnet" of public and private information services that will certainly contribute in preparing young and old alike for the information age both technically and intellectually.

In an effort to make this information widely available, we turned to the state public library system as a repository of historical and current information. As a result, the State is now witnessing an increase in the importance of the role of public libraries with the emerging technologies of our times from a repository of print media to a resource center of information in other media especially in the area of electronics, film, and audio. It seems appropriate that this new role includes gaining access to timely information about the Legislature. This is even more advantageous for Hawaii, as many of our libraries have been forced to close or cutback services of their government documents sections due to lack of sufficient staffing. Offering timely, accurate, and relevant on-line government information, provided by government agencies, is a step towards filling this gap.

Another educational perspective is the Legislature's desire to have *ACCESS*, through electronic messaging and conferencing on ACCESS Net, promote thoughtful and literate written communication among students and adults. Just as the establishment of postal services in various countries provided the desire among the people to learn to read and write, the Legislature would like to see *ACCESS* encourage the development of electronic communication skills for Hawaii's people. As we see the importance of manual labor decrease with the coming of the Information Age, verbal and intellectual skills will increase in use and value. It is our desire that *ACCESS* participants would be honing these valuable skills in addition to the art of justifying personal opinions and persuading or being persuaded to nurture a true participatory democracy and better quality of life for Hawaii's citizens.

ACCESS has also served as an excellent opportunity for the state Legislature to more effectively serve the public by delivering services to an individual's home or office that were previously available only at the Capitol. *ACCESS* has offered us the means to overcome geographical obstacles in providing equal access to legislative documents and information to isolated rural and Neighbor Island residents previously enjoyed by Honolulu residents only.

Prior to *ACCESS*, it was very difficult to track legislation or obtain copies of proposed laws or hearing notices in a timely manner. It would take the print shops three to five days before copies were ready for the public. Also, acquiring copies of committee hearing notices, measures, and committee reports required several visits to the Capitol. These documents are now efficiently accessed using *ACCESS* from the convenience of one's home or neighborhood library. Only the actual presentation of public testimony requires a visit to the Capitol by any citizen.

Even those without access to a computer and modem are given opportunities to retrieve the available data through 210 terminals located in all 49 State libraries, breaking down any barriers of an "information elite" among those who can afford a terminal, modem, and other technologies. As an added benefit, visually and hearing impaired and physically disabled citizens now have access to services and information from their homes, thereby broadening the application of equal access. It is also hoped that the use of videoconferencing via the State's network for hearings and town meetings with legislators located in Honolulu will also bring the Legislature one step closer to these special populations.

ACCESS also affords legislators an opportunity to be involved in public education services as they make presentations to students and community groups about the legislative process and *ACCESS*. This not only benefits the public, but also serves as an excellent chance for the legislators to interact on a personal basis with constituents and "keep in touch", and to encourage participation in the legislative process.

The Legislature believes in the inherent right of all American citizens to know about their government's activities and to be heard. To demonstrate our commitment to these fundamental principles of democracy, we have provided a free public service to the citizens of the State, through *ACCESS*, to provide meaningful access to public information and documents at the Legislature and also promote the exchange of ideas and opinions on current issues and future directions for the State. It is our hope that this new means of interacting and communicating will encourage discussions on a number of issues and peak the interest of more residents to become involved in the legislative process, thereby partaking in the shaping of Hawaii's future.

As most governments have recognized that a strong telecommunications infrastructure plays a vital role in the efficiency and success of achieving economic goals, the Hawaii State Legislature has always encouraged and promoted economic development and diversification for Hawaii, especially in high technology-related industries. Hawaii must foster the development of technology-oriented businesses, such as information industries, to support the growth of the economy of the State, provide adequate employment opportunities, encourage economic diversification, and improve the quality of life for Hawaii's citizens.

Some of the initiatives supported by the Legislature include the development of a computer software industry in Hawaii, encouraging and fostering the application of advanced technologies in local industry, supporting the development of high technology research, and capitalizing on the State's strategic geographical location and telecommunication infrastructure to provide trading of securities in Asian markets.

It is our belief that by fostering diversity in the economy, Hawaii's citizens can enjoy a better quality of life and economic opportunities. In a nutshell, *ACCESS* has demonstrated the potential for growth in electronic information services in Hawaii. With over 20,000 log-ins over a four-month period during session, *ACCESS* has demonstrated that there is a large user base in Hawaii eager to utilize information services. This user base is a beginning to the establishment of a "critical mass" of users to access both public and private information services to support a new way to communicate, and a new information industry.

5. Background of Hawaii's Statewide Information Network and *ACCESS*

A brief chronology of events is summarized below and significant events are described to provide an understanding of the history of the Legislature's initiative.

CHRONOLOGY

1987-88	• House of Representatives Telecommunications Work Group
1988	• Act 1, First Special Session of 1988: Hawaii Telecommunications and Information Industries Act of 1988
1989	• Capitol Bulletin Board System • Act 331, SLH 1989 (funding for statewide information network and public access) • Legislative Access Committee interim study
1990	• AudioACCESS • *ACCESS: Legislative Information Service*, v.0.1 Release • Pilot Fax Project • *ACCESS: Legislative Information Service*, v.1.0 Release, for public libraries access • Legislative Access in Hawaii: A Report to the House of Representatives by the House Legislative Access Committee • Act 347, SLH 1990 (funding for public terminals) • *ACCESS: Legislative Information Service*, v.2.0 Release, with ACCESS Net • Hawaii's Statewide Information Network, demonstration release
1991	• *ACCESS: Legislative Information Service*, v.2.1 Release

5.1. Telecommunications Work Group

The Legislature's commitment to make the most of telecommunication and information technologies began in 1987 when the House of Representatives established a Telecommunications Work Group to explore the field of telecommunications to ascertain its potential for expanding economic development; determine the capabilities and limitations of Hawaii's telecommunications infrastructure; identify opportunities for the use of Hawaii's telecommunications infrastructure; explore ways to forward Hawaii's potential role as a telecommunications center of the Pacific; and propose actions relating to telecommunications that would expand economic development in Hawaii.

The Work Group found that information has become a valuable commodity, critical to the success of business, government, and academic institutions. Work Group members agreed that the means of moving this information quickly and easily between Hawaii and the Pacific Basin countries, even the world, is through telecommunications. Possessing the ability to move the information on a timely basis could open doors to increased productivity in both the public and private sector, the development of new markets for business, more efficient delivery of government services, wider dissemination of educational offerings, and the development of a new information industry.

As a result of the numerous interviews and studies conducted by the Work Group, individual members foresaw an excellent opportunity on the horizon for Hawaii to be placed in a position where the establishment of Hawaii as an "information hub of the Pacific" could potentially be a tremendous benefit to the people and economy of the State.

The Work Group concluded that the establishment of a new information industry in Hawaii could expand economic development for the State by providing new business opportunities and jobs for Hawaii's citizens. Additionally, the establishment of a premier telecommunication infrastructure in Hawaii would certainly contribute to the flourishing of the Information Age for Hawaii as well as the entire Pacific Basin.

The group issued a report in January, 1988, which stated:

> *We have begun an era in which all the cities of the Pacific and the world will be linked together in a global community--via telecommunications. Information about our governments, businesses, and peoples crisscrossing the Pacific with ease open up new economic opportunities for Hawaii, particularly in the international arena. The Telecommunications Work Group examined the field of telecommunications and found a means through which our state can become the information hub of the Pacific.(1)*

5.2. Hawaii Telecommunications and Information Industries Act of 1988

As a result of the vision set forth by the Telecommunications Work Group, the Legislature passed Act 1, First Special Session of 1988, "The Hawaii Telecommunications and Information Industries Act." This landmark legislation was a pivotal point in Hawaii's history as it launched the State into the forefront of the Information Age. The underlying concept in the creation of Act 1 was that unlike those who lived during the agricultural and industrial ages, when wealth was determined primarily by land, labor, capital, natural resources, and the accumulation of money and weaponry, we are now living in a new age: a time in which we rely on information, knowledge, and intelligence.

This legislative initiative focused on establishing the Hawaii Information Network Corporation (Hawaii INC), as a public, nonprofit corporation to: (1) support and encourage development of an information industry to promote diversity of Hawaii's economy; and (2) manage, foster, and cultivate development of private information services for the statewide information network.

Act 1 also required the State of Hawaii Department of Budget and Finance to:

1. Develop and operate the infrastructure for the state-of-the-art microwave and telecommunications network to link state facilities on all the islands into one statewide information network;
2. Provide a single point of access for the public through a gateway to the various public and private information services; and
3. Provide access to public records through telecommunication and information technologies, ensuring that Neighbor Island residents have equal access to such information.

With the enactment of Act 1, we made a bold pledge to establish Hawaii as a leader in the emerging telecommunications industry in the Pacific. This is evidenced in the findings and purpose of Act 1 which states:

> *The Legislature finds that advances in telecommunications and information technology present significant opportunities for the State to develop and diversify its economy, establish an information industry, and promote access to data. Telecommunications presents a means of transmitting information quickly and inexpensively between Hawaii and all parts of the Pacific Basin and the world, thereby creating an opportunity to develop a new industry. It will require an active involvement by government to stimulate the creation of information industries in Hawaii. Such an industry, in and of itself, would serve to expand and diversify Hawaii's economy.(2)*

5.3. 1989 Legislative Session Activities

The idea for *ACCESS* was conceived during the 1989 Legislative session, when there was much concern expressed by the public and the media regarding demands for legislative information and services which were not being met in a timely manner. The media attributed this problem to mismanagement rather than malice on the part of the Legislature. Regardless of the attributed cause, the message from the public and press was clear: something had to be done to make the legislative process more efficient and provide an environment which encourages public participation in the democratic process.

Of the three branches of government, the Legislature relies most heavily on direct public input. We pride ourselves on providing quick, responsive services to the public; however, legislative sessions have become more hectic in recent years with an increasing number of complex measures to be considered each year, which place undue demands on the public to effectively participate in the process. Since we strongly believe that an informed and active citizenry is the most dynamic force in democracy, our inability to meet demands for legislative information and services prompted the consideration of Act 331, Session Laws of Hawaii 1989, by the Legislature and the establishment of the Capitol Bulletin Board Systems (CBBS) during the 1989 Session.

The CBBS was the first pilot project for electronic access of legislative information offered to the public. The CBBS enabled people to request copies of measures and view notices of committee hearings. Users could also communicate with each other about legislative issues, providing a means of creating new networks of people interested in pursuing topics of concern to the legislature. The CBBS also afforded the first opportunity for Neighbor Islanders to be part of the legislative process without having to fly to Honolulu or incur long-distance telephone expenses. With more than 600 users, the demand for legislative information through the CBBS was so great that it prompted legislators to examine how such technologies could be used to give citizens increased opportunities to participate in the legislative process.

Due to our strong belief that the public must be involved in the legislative process for our democratic system to work, the Legislature passed Act 331 (S.B. No. 823). This Act directly addressed public access concerns including proposing to use technology and telecommunications as a primary means of meeting the need for timely access by the public to the legislative process and legislative information, in addition to overcoming geographical obstacles of our unique island state. This Act created a committee composed of House and Senate members to evaluate how to increase the overall efficiency of the Legislature and to develop and promote better public access to its data.

With many legislators being "computer literate" and familiar with telecommunication technologies, it was not difficult to convince the Legislature of the benefits in utilizing state-of-the-art advances to keep constituents abreast of legislative activities. To take advantage of these technologies, the Act also proposed to demonstrate to the public the ease with which everyday citizens could access information by providing funding for public access terminals in public schools and state public libraries. This law also provided for the development of instructional videotex projects and the placement of public terminals at convenient locations. Act 331 set in motion the Legislature's commitments and beliefs by stating:

> *Opening up government processes to public scrutiny and participation is the most viable and reasonable method of protecting democracy and the public interest. Technology and telecommunications are the means by which improved public access and participation in the legislative process will become a reality. Now is the time for the State Legislature to act: to forge ahead as a pioneer in the Age of Information.(3)*

5.4. 1989 Interim Activities

During the 1989 interim, the Legislative Access Committee and the respective leadership of both chambers spent six months developing a number of potential solutions to the problem areas raised during the 1989 session. However, before any recommendations could be formulated, the Committee felt it was best to proceed cautiously and investigate trends in other state legislatures.

Therefore, a nationwide survey of the other 49 states was conducted to find the extent to which other legislatures administer and provide public access especially through technological means. It was found that the current emphasis in state legislatures across the country is on effective, accessible, and responsive services for the public. Repeatedly, it was found that timely and receptive service to the public is an increasingly vital part of a legislature's most important functions. The Committee also discovered that more than 50% of the legislatures provide on-line access to the public. It is interesting to note that in most of these states, the public's demand for information is satisfied by fee-for-service arrangements, in many instances, coupled with statutory provisions which mandate that any monies collected be earmarked for the management and/or maintenance of their public access systems.

In addition to this national survey, a survey was also conducted within the State to determine the legislative information needs of Hawaii's residents. Statewide public hearings were also held to receive testimony from concerned citizens and organizations regarding their public access needs. The survey and hearings indicated an overwhelming demand from the public for better public access to all of the activities of the Legislature including electronic access to legislative information.

After examining the comments collected and conducting further research, the Legislative Access Committee decided to visit selected state legislatures, municipalities, and the United States Congress to observe firsthand how these governmental entities were meeting public access needs of their particular constituencies. The visits provided an opportunity to observe and learn about various public access applications being used which not only provided good ideas and confirmed the appropriateness of the Committee's plans, but served to clearly indicate that Hawaii's government should take bold initiatives to provide for expanded access and participation in the legislative process.

As a result of the interim study, the Legislature adopted an Action Plan prior to the start of the 1990 Legislative Session which laid out numerous activities and projects for improving public access and participation to the legislative process. Among the many recommendations made included in the plan were the following activities or operational objectives: providing 24-hour electronic access to legislative documents and information; educating citizens about the significance and possible uses of legislative information and the legislative process; supporting widespread public participation in the legislative process; and supporting legislators in the timely provision of services to their constituents and the public.

The Committee's recommendations provided an excellent opportunity for the Legislature to demonstrate our commitment to public access, and resulted in our participation in the statewide information network by becoming its first information provider with our legislative data. In terms of significance to the democratic process, Hawaii's statewide information network has become the means by which improved public access and participation in the legislative process has become a reality.

5.5. 1990 Session Activities

One of the first items of the Action Plan to be implemented was the AudioACCESS system during the first week of the 1990 Legislative Session. This system allows the public to obtain information on the current status or disposition of measures on a 24-hour basis. A touchtone telephone is used to connect to DEC's MVSS, which then produces a digitized voice relaying the appropriate information for a given measure. Toll-free phone numbers were made available for Neighbor Island residents.

Early February, 1990, marked the inauguration of "*ACCESS: Legislative Information Service*," when for the first time in Hawaii's history, citizens across the state could get timely information including the text to bills, resolutions, committee reports, and hearing notices as well as information on the Legislature and its members, and the legislative process simply by using a personal computer and modem. Through the benefits of state-of-the-art technology, residents of all the islands, regardless of where they lived, could now overcome geographical obstacles and access legislative information just as easily as if they were right down the street from the State Capitol. Also, toll-free facsimile services for immediate transmittal of testimony and correspondence were made available to the Capitol including free faxing services from public libraries throughout the State.

In April, *ACCESS* became a truly public system for all residents when it went on-line at all 49 state public libraries, thus enabling people without computers and modems to retrieve up-to-date and timely legislative information in their own neighborhoods.

During this period, a report by the House Legislative Access Committee entitled, Legislative Access in Hawaii: A Report to the House of Representatives, was published which describes the efforts undertaken during the previous summer and fall by the Committee to develop recommendations to make to the House of Representatives for the 1990 Action Plan for improving public access and participation in the legislative process. Their endeavors and recommendations stated in this report has laid the framework for a strategic plan for legislative access projects to be undertaken by the House. The report stated:

> *The Legislative Access Committee's 1990 Action Plan was implemented with the support and cooperation of the leadership and the membership of both houses. Public response to these actions have been favorable, and informal user-surveys indicate that successful and energetic progress enhanced public access during the 1990 legislative session. However, the House Legislative Access Committee is mindful of rising public standards of openness and accessibility to legislative information and is, thus, continually seeking ways to improve public access to legislative information and the legislative process.(4)*

Encouraged by the success of *ACCESS*, as seen in the 20,000 logins recorded during the 1990 session, we felt that there was still room for improvement, necessitating growth and a second phase to the legislative access projects.

Due to the Legislature's commitment to ". . . provide young people, the leaders of tomorrow, with a knowledge base that will prepare them for lifelong learning in an information-literate society,"(5) the Legislature passed Act 347, during the 1990 Legislative Session which provides terminals and printers to all 232 public school libraries in the state. In addition, terminals have also been provided by this Act to each student in one class in each of the seven school districts to take home to do assignments and to share with their family. We also saw a need to increase the accessibility to *ACCESS*. Therefore, this Act provided for additional public terminals for the state public library system, University of Hawaii libraries, court libraries, and Neighbor Island state office buildings.

5.6. 1990 Interim Activities

After the adjournment of the 1990 session, a local survey was conducted to collect comments and suggestions on the 1990 access projects. As a result of this survey and comments gathered by the *ACCESS* Help Desk, we undertook the development of a more comprehensive and integrated *ACCESS* system. In September, 1990, several enhancements were made to simplify the user interface to *ACCESS*, v.2.0. Also, a new computer conferencing and electronic mail feature, named ACCESS Net, was added. Through ACCESS Net, we have provided a new forum for statewide town meetings, organizational networking, consensus building, and interisland communication which is effortless and guarantees instantaneous and wide dissemination.

In addition to the local survey, another round of statewide public hearings were held by the Legislative Access Committee during the 1990 interim. Besides the many positive and constructive comments that were made by the individual submitting testimony, these hearings marked another first for public access in Hawaii with a new type of access for Hawaii's residents through videoconferencing. These hearings were videoconferenced via the Hawaii Interactive Television System (HITS) between the Big Island, Maui, Kauai, and Oahu. This medium allowed committee members on Oahu to see and converse with testifiers on the Neighbor Islands without leaving their island of residence. In addition, the Legislature was also able to save on travel expenses. This venture has become another way of conquering the geographical barriers of our State.

In addition to these initiatives, an update of the 1989 Nationwide Survey was conducted during the 1990 interim. The results indicate that Hawaii currently is the only state in the nation to offer free access (including toll-free phone numbers) to a full range of electronic services including: access to legislative public documents; information on the Legislature and the legislative process; computer conferencing; electronic mail; fax processing; audio bill status information; and videoconferencing.

SERVICES OFFERED BY HAWAII'S LEGISLATIVE ACCESS PROJECTS

Service/Information	No. of Other States that Provide Service/Information
E-Mail/Bulletin Board	3
Facsimilie	5
Toll-Free Telephone Nos.	19
Bill Status	27
Bill Text	15
Committee Reports	6
Legislative Calendar	17
Legislative Digest	4
Hearing Notice	17

In September, 1990, *ACCESS* took on a new focus towards educational applications. Since its inception, one of *ACCESS's* goals has been to educate the citizens of Hawaii. Therefore, we felt a compelling responsibility to place a special emphasis on working closely with the Department of Education to develop special programs utilizing *ACCESS* for Hawaii's students. It is our belief that it is important to attract and interest students in the legislative process as well as the technologies involved as one of the means of preparing them for their roles in an information society.

In this regard, the Legislature has provided for the deployment of approximately 500 videotex (Alextel) terminals to 232 public schools. This provides for a terminal and printer in all school libraries which can be used to retrieve information not only from *ACCESS* but from the entire range of information services being offered over the Hawaii's statewide information network. In addition, one class in each of the seven school districts are participating in the Department of Education's videotex project which allows each student to take home a videotex terminal to do assignments and get better acquainted with the legislative process.

As the Legislature convenes on January 16, 1991, it will be releasing version 2.1 of "*ACCESS: Legislative Information Service.*" This release will contain further refinements to *ACCESS* which will provide easier and more timely access to information.

6. Future Plans

There is no doubt that with *ACCESS* and Hawaii's statewide information network, the Legislature has established a solid foundation for the development of public access and participation in the legislative process. Although much work remains and additional improvements are possible, we must continue to expand our commitment to this endeavor. Many new changes have been implemented since our first efforts a year ago, nevertheless, we realize that this is not the end but a beginning for a new era of increased citizen participation in the legislative process in Hawaii.

Having been encouraged by the public's response to the legislative *ACCESS* offerings, there are plans to further improve on legislative access projects. We would like to build a stronger *ACCESS* foundation by strengthening the education, economic development, and public services cornerstones. There is a need to develop public education on the importance of telecommunications and information services to the social and economic future of the State. Public services will be reinforced by providing the public with more aids to tracking bills and searching legislation and statutes and increasing accessibility with more public terminals, more phone lines, and the ability to accommodate more concurrent users. It is our hope to bring the Legislature to every community in the State with government leaders becoming facilitators to the information vital to creating an informed citizenry. We are excited about these projects and, in the near future, hope to make Hawaii a national leader in the area of public access.

We would also like to promote the concept of *ACCESS* as a means of providing public education by making it a model for other Pacific communities. We believe that there is an important correlation between the economic success of a country and the commitment its government makes to attain a well educated and informed population. Many Pacific countries serve as excellent examples of how countries poor in natural resources can become prosperous by placing a priority on its human resources. On a number of different occasions, we have seen how countries that place a premium on the education of its people experience rapid economic growth.

Many Pacific countries face geographical challenges, like Hawaii, being island jurisdictions. It is hoped that Hawaii's information services, especially *ACCESS*, can serve as an example of the role government could play in overcoming these obstacles through the use of current and emerging telecommunications technologies to promote education, economic development, and public service. It is the Legislature's intent to have Hawaii be an integral part in launching the Pacific Basin as worldwide leaders in telecommunication, information industries, public education, and participatory democracy.

Notes

(1) Hawaii. Legislature. House of Representatives Telecommunications Work Group. Fourteenth State Legislature. Work Group Report, Executive Summary, p. 1.

(2) Session Laws of Hawaii 1988. Act 1, Special Session of 1988, p. 968.

(3) Session Laws of Hawaii 1989. Act 331, p. 983.

(4) Hawaii. Legislature. Legislative Access in Hawaii: A Report to the House of Representatives by the House Legislative Access Committee. (Honolulu: 1990), p. 41.

(5) Session Laws of Hawaii 1990. Act 347, p. 11.

VIDEO ON DEMAND:
Switched Urban Programming for Educational Resources - Metropolitan Area Network (Super-Man)

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ABSTRACT

Saskatchewan has long been a leader in development of new information services for the province's residents and educators. The provincial telephone company, SaskTel, has been carrying out "video on demand" trials involving delivery of educational programming for the past three years. These trials have involved a broad spectrum of technical information delivery services in the province, including analog and digital telephone, fiber optic, cable, and satellite developments. Recent trials have been code named "Project Glass" and "Super-Man". This paper reports on technical and educational aspects of these trials. Specifically described is the educational application entitled "Super-Man 1", rapid access to networked video tape by schools.

Introduction

Residents of Saskatchewan have always considered information to be a vital commodity. Remoteness, sparsity of population, and the early adoption of the principle of "universality" have played a major role in the priority placed on "equal access to information for all residents" by the government of Saskatchewan. In 1887 , six years after Alexander Graham Bell invented the telephone, our province's administrators recognized telecommunications as a force to bring communications to each resident and set out to establish a province-wide network. Since that time each succeeding government has supported the Saskatchewan telephone company as a monopoly, and SaskTel has developed a world class telecommunications network across the entire province. Broadband telecommunications is within reach of every Saskatchewan resident, no matter how remotely located.

Saskatchewan residents enjoy the longest fiber optic network and more telephones and cable hook-ups per capita than any other population in the world. Business, industry, and the public are extremely well served by existing communications networks. The same systems are capable of providing world class service to the education sector. Two factors have prevented exploitation of existing communications services by education systems in the province of Saskatchewan. One of these is the tenacity of top level education administrators as they cling to traditional methods and regard as sacrosanct the territory of the "ivory tower". In addition, because education does not provide the same measure of profitability as do business and industry, the use of communications networks for distance learning in Saskatchewan has been constrained, despite pressing need for and viability of education at a distance.

The greatest demand for distance learning in Saskatchewan is in the areas of life-long learning, training, re-training, and provision of a wider curriculum options to small, low enrollment, remote elementary and secondary schools. Prominent throughout the educational history of Saskatchewan is an aspiration to provide learning resources equitably to all learners. Improved telephone, transportation, and mail systems during the past three decades have resulted in an improvement in delivery of traditional correspondence, extension, and training courses, as well as media and print resources to schools. However, equity of learning opportunity has never been achieved; this is due, in part, to the economy of numbers which allows for better access to learning, training, and media resources in the population centers than in rural and outlying areas.

Setting the Stage

Broadband in the form of cable and fiber optics has been available to eighty percent of the population for almost fifteen years, and satellite brought the remainder on stream in 1981. Business and industry adopted each telecommunications advance with alacrity, and the telco flourished. Educational institutions, including the provincial education department, universities, colleges, schools, and technical institutes, did not embrace telecommunications with the same passion. During the fifteen year period when business and industry adopted advances in communications, educators tended to ignore telecommunications in favor of traditional methods of information distribution; the gulf between population centers and rural and remote areas broadened.

The literature is rife with rationale underlying the reticence of the educational establishment to be among the early adopters of improved technical modes of information delivery. Motivation, money, and an abiding conviction that traditional methods are better lead the list. The reactionary stance of the educational establishment should not be decried, because over the years it has been effective and efficient in respect to the numbers of students a traditional institution is capable of educating. The scale tips when the pace of change creates an overwhelming need for training and re-training, and an exponential increase in information dictates educating larger numbers than traditional institutions are capable of reaching. A weight on the side of distance learning, and one which predicates in favor of telecommunications, is the need for learning to occur where the learner resides rather than at the place of learning. Change in the way we do things requires a catalyst and time. This paper describes how both have contributed to an innovation in telecommunications that promises to increase equity of access to media resources for all Saskatchewan schools, large or small, remote or urban.

From Itinerant Projectionist to Super-Man

Saskatchewan has a long tradition of providing media resources to the schools, beginning with the itinerant purveyor of 16 mm motion pictures who arrived at the school on an erratic schedule, replete with portable generator, blackout curtains, and projector. This highly appreciated resource grew into the Visual Education Branch of the Saskatchewan Department of Education and further evolved under the auspices of SaskMedia, Educational Media Services, and now Media House, a privatized business. While this service has been augmented by the delivery via public broadcast of a small amount of radio and televised school broadcasts, each agency has relied mainly on traditional means of film and videotape distribution and circulation, that is, delivery to the school and the learner by means of mail, bus, and truck.

Small rural schools and far-flung northern schools are hardest hit by the disparity between rural and urban access to information and resources, and demands continually increase. The trend to "resource-based learning" assumes a diversity of audiovisual curriculum support materials. New curricula in chemistry, biology, and physics; a new arts education curriculum and French language instruction, for example, rely heavily on non-print resources for provision of effective instruction. Duplication and distribution of multiple copies, transportation across Saskatchewan's expansive geographic area, turn-around time, and finite funds are obstacles which stand in the way of valiant attempts at equitable distribution of resources.

A fortuitous combination of events set the stage for what appears to be the answer to delivery of media resources via the great leveling medium, videotape, to the schools of the province. The sequence of events was initiated by installation of a province wide fiber optic network by Saskatchewan Telecommunications and early satellite trials at the University of Saskatchewan. These broadband initiatives culminated in the creation of the Saskatchewan Telelearning Association (STELLA) and the Saskatchewan Communications Advanced Network (SCAN), later to become the Saskatchewan Communications Network (SCN). SCN absorbed the fledgling narrowcast network established by STELLA and formed a provincial educational communications network dedicated to providing "equal access to information for all residents" (SCAN, 1989).

SCN's parallel network, the public educational cable television channel, has been aggressively acquiring video programs cleared for both broadcast and classroom use. A growing inventory of original productions and acquisitions injects much needed programming to bolster available resources. SCN's pilot projects for the delivery of secondary courses has initiated interest in the purchase of satellite receiver dishes for high schools. By making the technology affordable with low cost lease and maintenance packages, secondary schools in rural Saskatchewan are tantalized by the potential cache of resources accessible to them by a telecommunications network.

While distance education by satellite was rapidly becoming a reality of the 1980s, the Research and Development Branch of Saskatchewan Telecommunications was experimenting with rapid access video and video on demand under the guidance of Graham Bradley (Bradley, 1986). This early experimentation led to Project Glass (Bradley, 1989) and the Super-Man trials (Bradley, 1989; Bradley, 1990).

The synergy of SCN's massive infusion of programming into the educational sector and the growing reality of satellite distribution of information to rural secondary schools, in tandem with SaskTel's development of Super-Man technology has resulted in the melding of software, hardware, and human resources to cast a new mold for serving the needs of Saskatchewan's schools.

Roots of Super-Man

The roots of "Super-Man", a "video on demand" application, lie in early adoption of a broadband fiber optic network and satellite delivery of credit university courses in Saskatchewan in the early 80s. Among the dozen or so telecom innovators who were the catalysts that led to Super-Man, two names stand out: Danielle Fortosky and Graham Bradley. Fortosky, Director of the Division of Audiovisual Services at the University of Saskatchewan, relentlessly pursued the establishment of university credit courses at a distance; this resulted in Uplink '81, Uplink '84, Uplink '86, Saskatchewan Telelearning Association (STELLA), and the Saskatchewan Communications Network (SCN). This pivotal pioneering work is described in the following papers: Brown, 1989; Brown, 1990; Fortosky, 1984, and Scissons, 1984. Graham Bradley, Director, Research and Development, Saskatchewan Telecommunications, stands out for his quest to discover the best technological manner to deliver information to his creation "Res Man". "Residential Man", a visual metaphor to aid in the description of communications paths to home, is credited with the creation of Super-Man 1, 2, and 3 to deliver information to the student and teacher. Bradley has pioneered work in long haul fiber optics for digital video and telephony, multi-channel analog television for fiber optics, video-on-demand databases, on-line video control from homes, multi-band fiber optics to the home, and automated video store and forward via night owl satellite service. Super-Man, Switched Urban Programming for Educational Resources -Metropolitan Area Network, is an out growth of all that went before.

Early Trials

A brief description of the trials leading up to Super-Man follows.

Video on Demand

Full motion video, consumer selected and controlled, delivered to the home or school, elicits high consumer satisfaction. This is attested to by the popularity of the pick-up-return movie rental industry which has emerged with the availability of inexpensive VCRs and the decision of the movie industry to release large quantities of program material to the consumer. Profits from the movie rental industry have been enormous and sustained. Video on demand delivered to the home television set, at comparable cost to the rental store, providing for similar consumer demands, that is, control over selection, time, and condition of viewing, but sans VCR and trip to the rental store, would logically enjoy high consumer support.

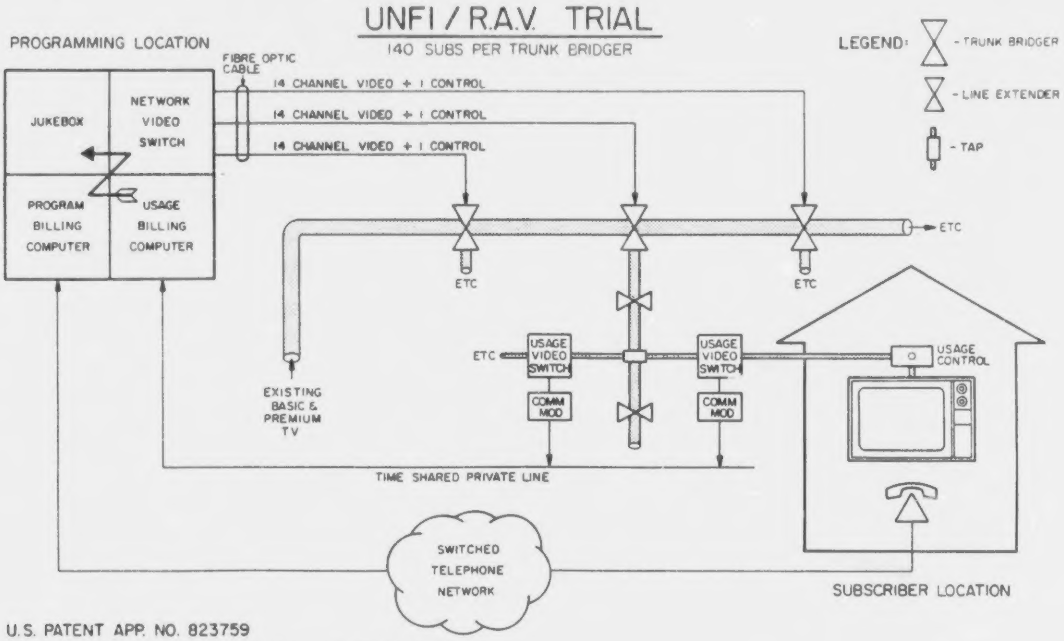
The obstacle complicating this scenario is the traditional separation of cableco and telco. The cable company has the broadband path to the home and the technical expertise associated with bringing full motion video into the home. The telephone company is the undisputed expert in narrowcasting and associated switching and has the narrowband path to the home.. Neither company has ready access to the volume of information that would drive video on demand to profitability. Bradley brings it into perspective with this comment:

> Video on Demand requires broadband narrowcasting, so each player brings "half a deck" to the party. It is hoped the natural synergy the two entities would enjoy in making this new service a rising star, will prevail! Should this not be the case, a great deal of effort will be expended not only in duplicating the physical plant, but in the battle itself. ie: that close to the home ,we don't need competing sewer pipes, nor competing fibers (Bradley, 1989).

In Saskatchewan the common denominator to video on demand appears to be fiber in the subscriber loop. Once the long haul fiber distribution network was a reality in the province, research and development began into delivery of Random Access Video (RAV) to the home subscriber. The initial plan was to use "Up Network Fiber Injection, the overlay of fiber optics on part of the coaxial cable television plant" and market test "residential Random Access Video with subscriber driven distributed video switching and employing the Video Party Line concept". Figure 1 provides a technical overview of early RAV trials. A video on demand trial code named "Project Glass" was initiated with the technology changed "from an analog fiber/coax hybrid at the trunk bridger amplifier, to an all fiber analog/digital hybrid to the subscriber's house wall" (Bradley, 1989).

Project Glass
Technical Overview

Project Glass launched SaskTel's "dial a video" concept, also known as the "video jukebox" (SaskTel's video, 1988). This pilot project involved connection of 144 households and 22 classrooms in Northwest Regina with networked access to 192 video tape recorders via digital fiber, copper, coax, and analog fiber. "A new cost-reduced fiber optics transmit/receive mechanism called 'linear photonics' is making the service possible. SaskTel transports the random access service over a 13-kilometer underground and aerial fiber trunk linked to coaxial distribution plant between the school and the switching centre" ("SaskTel's video," 1988). Subscribers were provided impulse on-line program selection of 192 educational videos available to a subscriber within a period of one minute.


UNFI / R.A.V. TRIAL
140 SUBS PER TRUNK BRIDGER
PROGRAMMING LOCATION
FIBRE OPTIC CABLE
14 CHANNEL VIDEO + 1 CONTROL
14 CHANNEL VIDEO + 1 CONTROL
14 CHANNEL VIDEO + 1 CONTROL
JUKEBOX
NETWORK VIDEO SWITCH
PROGRAM BILLING COMPUTER
USAGE BILLING COMPUTER
LEGEND:
- TRUNK BRIDGER
- LINE EXTENDER
- TAP
ETC
ETC
ETC
ETC
EXISTING BASIC & PREMIUM TV
USAGE VIDEO SWITCH
COMM MOD
USAGE VIDEO SWITCH
COMM MOD
USAGE CONTROL
TIME SHARED PRIVATE LINE
SWITCHED TELEPHONE NETWORK
SUBSCRIBER LOCATION

U.S. PATENT APP. NO. 823759

Figure 1. Early Random Access Video Trial. Note. From "Cost Effective Fiber Optics in the Subscriber Loop" by Graham Bradley, 1986. Reprinted by permission.

Touch-tone telephones and television receivers were installed in each of the 22 classrooms.for ordering and viewing programs. The video portion was delivered from the 192 VCR servers to the subscriber by the local cable company system.

Technically the trial concluded that if video on demand is not required, then VF copper and coaxial cable would remain the medium of choice for telephony and cable television for the last kilometer in the subscriber loop "Should Video on Demand be planned, the last mile would best be served by a single fiber starred to each home, providing a transportation path for both the existing telco and cableco signals, the Video on Demand itself and any other narrowband services as may appear". Figure 2 outlines technical characteristics of "Project Glass" (Bradley, 1989).

Educational Application

Participating teachers selected programs from a paper directory and dialed an access number on a touch-tone telephone to activate the program choice. Within one minute of access, students were watching the program on their classroom monitor. While teachers readily approved the convenience of "fingertip video", two recommendations arose from the test. "Teachers wanted full VCR functionality, not just pick and watch" (Bradley, 1990). This is indicative of the inherent difference in approach to passive entertainment viewership and active learner participation in instructional television. Sound instructional principles in the utilization of media in the classroom demand the capability of controlling the resource to facilitate planned learner interaction. Providing the mechanism by which the teacher can stop, start, and search the videotape would result in more effective use of the media resource.

Program changes made to the video bank inventory necessitated updating and redistributing the paper directory. This somewhat cumbersome process led to the project's second recommendation: the need to implement a database directory of programs and the provision for computerized access. It

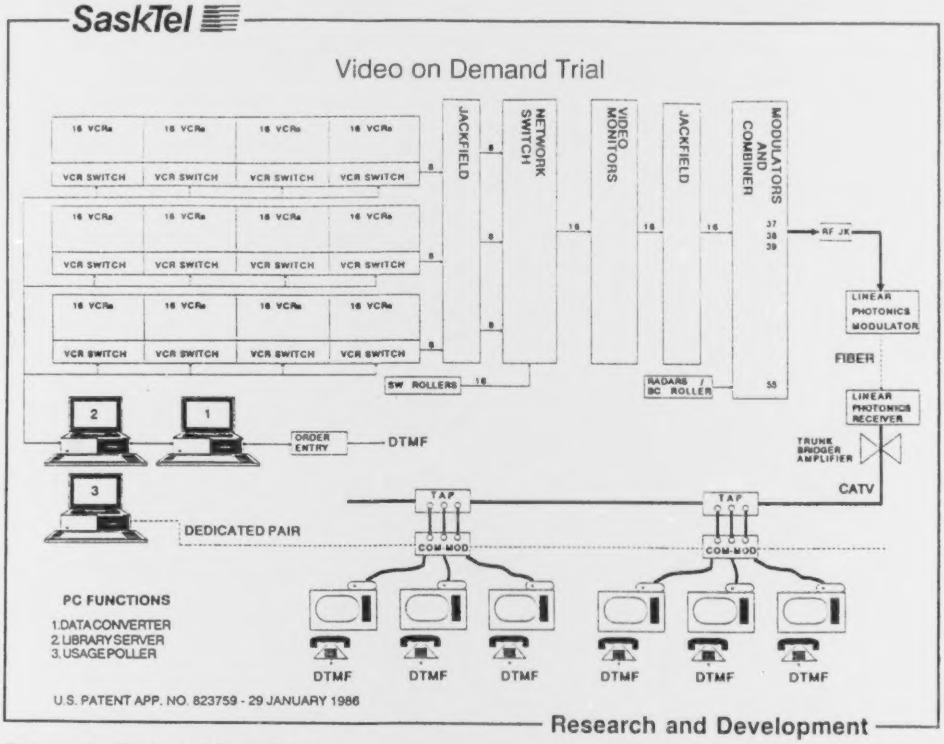

SaskTel
Video on Demand Trial
16 VCRs
VCR SWITCH
8
JACKFIELD
NETWORK SWITCH
16
VIDEO MONITORS
JACKFIELD
MODULATORS AND COMBINER
37
38
39
55
RF JK
LINEAR PHOTONICS MODULATOR
FIBER
LINEAR PHOTONICS RECEIVER
TRUNK BRIDGER AMPLIFIER
CATV
SW ROLLERS
RADARS / BC ROLLER
2
1
3
ORDER ENTRY
DTMF
DEDICATED PAIR
TAP
COM-MOD
PC FUNCTIONS
1.DATACONVERTER
2.LIBRARYSERVER
3.USAGEPOLLER
U.S. PATENT APP. NO. 823759 - 29 JANUARY 1986
Research and Development

Figure 2. Project Glass Trial.
Note. From "Fiber Optics for Local Distribution" by Graham Bradley, 1989.
Reprinted by permisssion.

was felt that the electronic directory would facilitate both timely and efficient cataloguing and accessibility.

Videotapes cleared for use on the dial-a-video service were made available through the National Film Board of Canada, the Regina Public School Board, and Educational Media Services of Saskatchewan Education. Access to cleared videotapes of an entertainment and human interest variety proved problematic for the trial period. "Although 144 houses are connected by the trial, we have yet to obtain suitable video tapes for distribution by our 192 VCRs" (Bradley, 1989). This aspect highlighted one of the problems inherent in distribution of information resources by non-traditional means such as telecommunications and is one factor preventing immediate acceptance of wider and more equitable distribution of information to home and school. Copyright, extent of distribution, and financial return to producer combine to create a situation which educators face with some difficulty. Cost and bureaucracy involved in cycling one to ten discrete videotapes to teachers throughout the province by mail, rail, or bus differ greatly from the cost of obtaining and paying for the right to distribute, on a random access basis, the same video via a telecommunications network. The price of information equity may be considerably higher than anticipated.

The "Project Glass" trial was positively accepted by teachers and students. Convenience of scheduling and elimination of ordering, re-ordering and shipping was cited by teachers as major advantages to video on demand (SaskTel's video, 1988). Project Glass evolved into the Switched Urban Programming for Educational Resources - Metropolitan Area Network (Super-Man) trials now underway.

Super-Man

Figure 3 provides a timeline and schematic of three video on demand Super-Man projects now in progress or proposed, by the SaskTel in cooperation with the Saskatchewan Communications Network. Super-Man 1. connects the school library to the classroom delivering networked video with full function VCR control. Super-Man 2 connects the originating library to the school library. Super-Man 3 proposes to network videodisc enhanced computer aided instruction from a central location to an individual workstation. (Bradley, 1990)

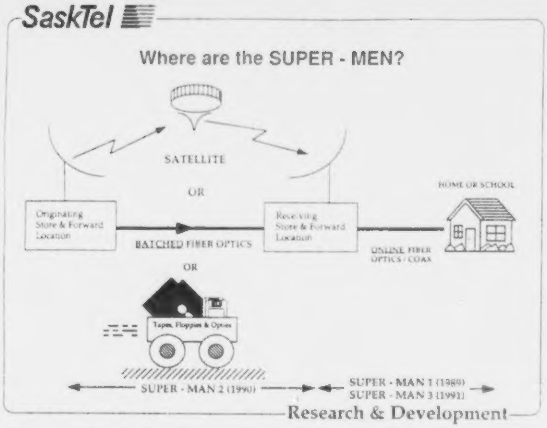

SaskTel
Where are the SUPER - MEN?
SATELLITE
OR
Originating Store & Forward Location
BATCHED FIBER OPTICS
Receiving Store & Forward Location
HOME OR SCHOOL
ONLINE FIBER OPTICS / COAX
OR
Tapes, Floppies & Optics
SUPER - MAN 2 (1990)
SUPER - MAN 1 (1989)
SUPER - MAN 3 (1991)
Research & Development

Figure 3. Where are the Super-Men?
Note. From Graham Bradley, 1990.
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Super-Man 1
Technical Overview

In the Super-Man 1 pilot sixteen VCRs were located in the school library and connected to classrooms via an in-house RF distribution system. Full function control of the VCR bank was executed by touchtone telephones located adjacent to the television receiver in each classroom. A televised program directory, listing a daily menu of programs, was transmitted on a dedicated channel to each classroom. Program selection was enhanced by video tapes delivered to the library or by satellite "forward and store" delivery. Technical configuration is described in Figure 4.

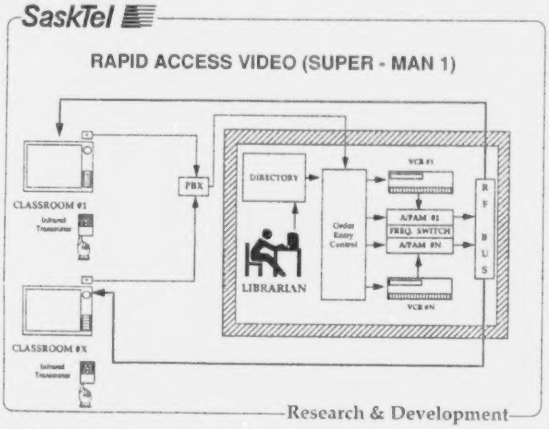
SaskTel
RAPID ACCESS VIDEO (SUPER - MAN 1)
CLASSROOM #1
Infrared Transceiver
CLASSROOM #X
Infrared Transceiver
PBX
DIRECTORY
LIBRARIAN
Order Entry Control
VCR #1
A/FAM #1
FREQ. SWITCH
A/FAM #N
VCR #N
RF BUS
Research & Development

Figure 4. Super-Man 1.
Note. From Graham Bradley, 1990.
Reprinted by permisssion.

Educational Application

Three parameters identified during Project Glass were tested in this pilot: full function control of the remote VCR by touchtone telephone located in each classroom; delivery of new programs by satellite on a forward and store basis; and provision of an easily updated online directory. This configuration was field tested in two very different educational settings: a large urban collegiate and four small multi-grade rural high schools.

Eastend Pilot. The Eastend School Division is a rural school division located in the southernmost reaches of Saskatchewan. The division suffers the full impact of its remote location, exacerbated by a dwindling population and restricted budgetary resources. School administrators expressed the frustration of time delays and administrative headaches of ordering, tracking, and transporting media resources between schools.

Four multi-grade high schools in Frontier, Consul, Eastend, and Climax participated in the pilot. A grant from the Future Corporation, a government crown corporation, equipped the schools with satellite receive dishes and tuners. The pilot tested the capability transmitting programs from the Project Glass video bank in Regina to a satellite uplink in Saskatoon for subsequent satellite distribution to the four Eastend division schools. Approximately two hours of "night owl delivery", four nights of the school week, were available for program bookings. Receiving schools tuned their satellite receivers to the designated transponder and pre-set videotape recorders to record during the night owl time period.

Updated program directories and transmission schedules were delivered by facsimile to the four schools and confirmed by telephone. Problems with a paper based directory, experienced in the previous pilot, surfaced, highlighting the potential advantages of an electronically accessible directory. VCR operator error accounted for the majority of technical problems. These "finger" problems were primarily incorrectly setting the VCR, neglecting to load a tape, turn on the power, etc. However, the potential for successful distribution of media resources was evident. In addition to the benefit of increased access to and availability of media resources, the primary benefit of the trial was the capacity to simultaneously receive video material at all four schools, negating the traditional transport problems and time delays of "bicycling" materials from school to school. The pilot test period extended from January to April of 1990. During that period 146 videotaped programs were transmitted via satellite to the four schools.

Campbell Collegiate Pilot. Campbell Collegiate is a large, urban collegiate located in Regina, Saskatchewan. It has a student population of 1,206 in grades 8-12 and a faculty of 75, including administrators and part-time personnel.

What began at Campbell as the dial-a-video concept of Project Glass has evolved into a comprehensive in-house distribution system which has dramatically changed the way in which video-based hardware and software are utilized and administered. According to Bill Fleming, Campbell Collegiate's teacher-librarian responsible for the system, Super-Man 1 has changed the way in which teachers, students, and resource centre personnel do business. The new system turns the resource centre into "master control"; the administrative hub of the system. While hardware and software now seldom leave the centre, access to its video library has increased significantly.

In traditional libraries of contemporary Saskatchewan schools, the shift in mandate is to "resource-based learning" (Saskatchewan Education, 1987). Fleming suggests that the Super-Man 1 system supports and enhances the resource-based learning concept in which the resource centre is a multi-dimensional source of both print and media resources. Access to information and information processing tools and skills become critical components of the resource centre concept.

Prior to implementation of Super-Man 1,the teacher-librarian at Campbell managed hardware/software distribution by a checkout system in which the teacher booked videotape, television receiver, video player and cart and wheeled it to the classroom. Problems caused by equipment malfunction and operator inexperience were attended to by the teacher-librarian when summoned by the teacher. Complaints arising from the checkout system included: lost or late return of videotapes and equipment, wear and tear on the equipment, and loss of administrative time tracking and following up hardware/software problems. Fleming recalls that in the early days of implementing Super-Man, "Most teachers were terrified of using it", while today, students and

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teachers clamour to access videotaped programs through the system.

Representatives of Saskatchewan Telecommunications provided training during the implementation phase of the system. Care was taken to reduce the intimidation factor to a minimum and to make the training sessions as convenient as possible. A trainer took up residence in one of the staff rooms for a week at a time and saw teachers individually or in small groups. An invitation to "come and see me when you're free", sweetened with the prospect of a reward (cap and key-ring featuring "Rapid Access Video" logo) contributed to the success of the training. Simple step-by-step instruction cards, telephone keypad stickers, and a "hands on" practice trial reinforced the training.

In regular use teachers and students reserve videotapes with the resource centre. The teacher-libarian inserts the requested videotape in one of 16 VCRs and annotes the selected program on a "menu board". Menu information includes program title, scheduled viewing time, and teacher who will be using the program. A ceiling mounted camera focused on the menu board telecasts the daily menu or "viewing guide" on a dedicated channel to the entire school . Teachers then access software via touch-tone telephone. Once the program selection is made the user establishes full function VCR control with coded numerical instructions entered through the keypad of the touch-tone telephone. Resource Centre personnel monitor tape play-back quality from master control in the library.

Following an inevitable period of frustration with a new system, use of video-based resource materials increased three to four times over the former method of distribution. Fleming attributes this increase to the ease of access made possible by the Super-Man 1 configuration. Data generated by the system's computer indicates that in September, 1990, the system was accessed 190 times and in October, 213 times.

An unanticipated outcome has been the increased use of video resources by students. Fleming attributes this to "heightened awareness" by teachers to the use of television in the classroom. Students are accessing the video library to review curriculum related material and to provide audiovisual support for student research projects, reports, and class presentations. Another unexpected development is increased utilization of student produced videotapes which is again attributable to successful instructional experience with the medium.

Super-Man 2
Technical Overview

Super-Man 2, currently under construction, is targeted for pilot implementation in the fall of 1991. Super-Man 2 follows its predecessors, incorporating VCR control by the satellite's video signal (or any other video signal), teletext directory capable of 100 titles and program explanations, and provision for program voting to the central library. Figure 5 conveys an overview of Super-Man 2 and Figures 6 and 7 detail the head end and receive end configuration respectively.

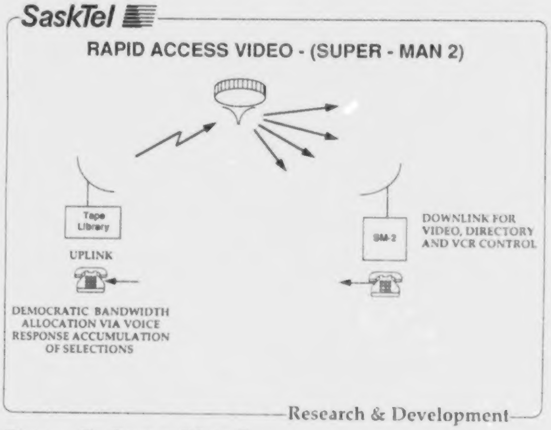
SaskTel
RAPID ACCESS VIDEO - (SUPER - MAN 2)
Tape Library
UPLINK
DEMOCRATIC BANDWIDTH ALLOCATION VIA VOICE RESPONSE ACCUMULATION OF SELECTIONS
SM-2
DOWNLINK FOR VIDEO, DIRECTORY AND VCR CONTROL
Research & Development

Figure 5. Super-Man 2.
Note. From Graham Bradley, 1990.
Reprinted by permisssion.

Educational Application

Super-Man 2 will be piloted in each of the schools that participated in the first trials. Four or more VCRs will be located in the school's library or resource centre. The central or originating library will transmit video programming to VCRs in the school library by satellite or batched fiber optics. The video signal from the central library will control VCRs at the school library, thus eliminating some capture problems associated with Super-Man 1. Once programming has been downloaded to the school, probably during night owl service, teachers and students will access video programming in the library VCR bank by touch-tone telephone as in Super-Man 1 trials. Super-Man 2 will allow the user access to an online program directory listing up to 100 program titles complete with short program explanations. This service will be teletext based and transmitted in the vertical blanking interval. These additions address two of the three constraints experienced during the initial trials.

The third constraint identified was associated with scarce bandwidth allocation, since satellite transmission was restricted to two hours per night. This period of time failed to deliver enough titles to satisfy program requests placed by teachers. Equitable delivery of video programs to requesting users was an imperative to which the Research and Development branch of SaskTel paid a great deal of attention. This resulted in development of software and hardware which gives Super-Man 2 the capability of "democratic broadcatching", a term coined by the director of the branch Graham Bradley (Bradley, 1990).

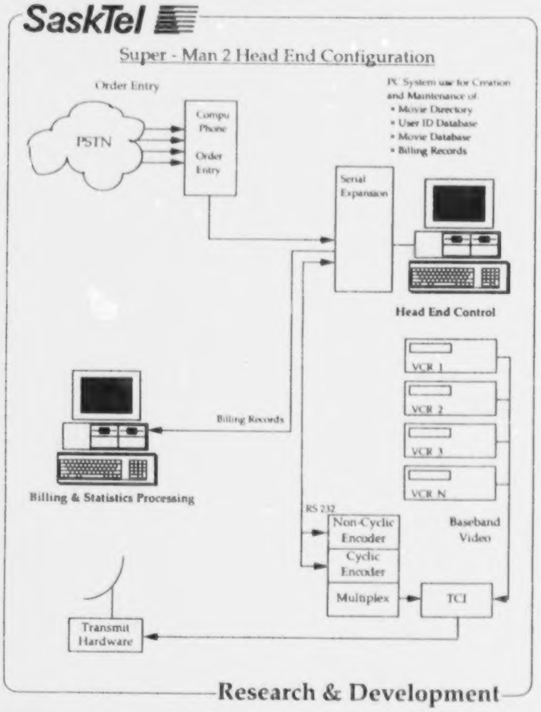
SaskTel
Super - Man 2 Head End Configuration
Order Entry
PSTN
Compu Phone
Order Entry
PC System use for Creation and Maintenance of
• Movie Directory
• User ID Database
• Movie Database
• Billing Records
Serial Expansion
Head End Control
VCR 1
VCR 2
VCR 3
VCR N
Billing Records
Billing & Statistics Processing
RS 232
Non-Cyclic Encoder
Cyclic Encoder
Multiplex
Baseband Video
TCI
Transmit Hardware
Research & Development

Figure 6. Super-Man 2 Head End Configuration.
Note. From Graham Bradley, 1990.
Reprinted by permisssion.

Democratic broadcatching holds great promise in providing user control over titles broadcast to the receive VCRs each night. Schools with capability of receiving programming will vote on programs desired by coded "voting", using the touchtone telephone to register the vote with the central library. Results of voting will establish priority of program title delivery to the extent of bandwidth and time available. Users will be able to "gang-up" on the voting which would allow time-specific curriculum resources to be delivered if a group garnered enough votes. For instance, chemistry teachers in all the division's schools could agree to vote for the same resource to be delivered during the same time. Democratic selection of titles, the forward and store aspect of Super-Man 2, and the possibility of retaining forwarded video tapes for later use combine to make it appear that transmission of as few as 8-10 titles per night will make a dramatic improvement on resource availability to urban and rural school alike.

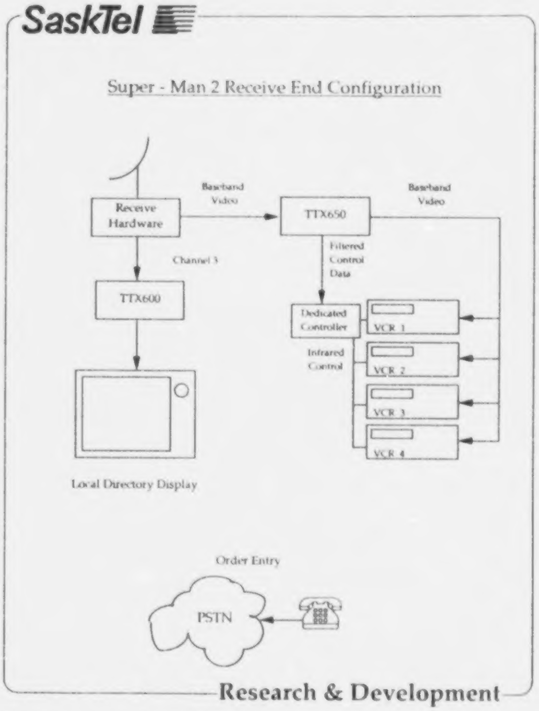
SaskTel
Super - Man 2 Receive End Configuration
Receive Hardware
Baseband Video
TTX650
Baseband Video
Channel 3
Filtered Control Data
TTX600
Dedicated Controller
VCR 1
Infrared Control
VCR 2
VCR 3
VCR 4
Local Directory Display
Order Entry
PSTN
Research & Development

Figure 7. Super-Man 2 Receive End Configuration.
Note. From Graham Bradley, 1990.
Reprinted by permisssion.

Super-Man 3 Technical Overview

Super-Man 3, as shown in Figure 8, networks videodisc enhanced computer aided instruction from a centrally located database to an individual workstation.

Educational Application

Developers involved in the evolutionary third stage of Super-Man predict that this stage will provide 'security, control and sharing of software, hardware and humanware resources" (Bradley, 1990). Centrally locating high cost hardware and networking equally high cost mediaware and humanware holds great educational potential for Saskatchewan's residents.

Cost

Development cost to the Research and Development branch of SaskTel has topped $1 million (Rapid access video, 1990). The trial at Regina's Campbell Collegiate received a $47,500 grant from the Future Corporation's Innovative Grant Program (Rapid access video, 1990). The Eastend School Division trials have expended approximately $114,000 in equipment, $50,000 of which was a grant from the Future Corporation and the remainder was received from the Saskatchewan Communications Advanced Network, SaskTel, and the Eastend school division (Satellite system, 1989; Fax machines, 1989). Personnel and plant costs or savings realized by the trials will not be known until results of the on-going evaluations are in.

Conclusion

Application of Super-Man 3 will bring the reality of "full-function" distance learning and distribution of learning resources a step closer. Consistent with tradition, Super-Man developments will extend information resources on an equitable basis to all Saskatchewan residents irrespective of their geographical location. Super-Man trials have been limited to schools in the province but also have broad applicability to other educational and training venues in post-secondary education, business, and industry. The prototype equipment is designed to complement the existing provincial communications system, telco, and cableco services.

Post-secondary education now has access to 50 SCN Learning Centres across Saskatchewan with 50 more envisioned to meet the design specification that no resident will be more than 30 miles from a centre (Brown, 1989; Brown, 1990). Each of these centres is satellite receive equipped with full access to telephone, facsimile, computer, and standard media devices. The majority of the province's universities, colleges, and institutes are likewise equipped. Delivery of educational software and human resources to learners anywhere in the province will be cost effective because high cost originating, storing, and distributing hardware will be shared.

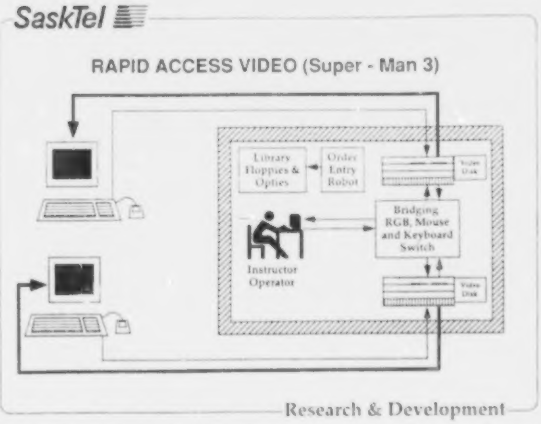
SaskTel
RAPID ACCESS VIDEO (Super - Man 3)
Library Floppies & Optics
Order Entry Robot
Video Disk
Bridging RGB, Mouse and Keyboard Switch
Instructor Operator
Video Disk
Research & Development

Figure 8. Super-Man 3.
Note. From Graham Bradley, 1990.
Reprinted by permisssion.

The technical platform needed to support educational endeavor in Saskatchewan, from "cradle to grave", is almost in place. Innovative use of telecommunications technology can now provide "equal access to information to all residents" (SCAN, 1989). It is now up to the province's politicians, educational administrators, educators, and citizens to harness this potential for the benefit of future learners in the province.

REFERENCES

Bradley, G. (1986). *Cost effective fiber optics in the subscriber loop.*. Regina, Saskatchewan: SaskTel. A paper presented to Fiberstat '86.

Bradley, G. (1989). *Fiber optics for local distribution. Regina, Saskatchewan: SaskTel. A paper presented to '89 CITA, Toronto.*

Bradley, G. (1989). *Project Glass: Some interesting results.* Regina, Saskatchewan: SaskTel. A paper presented to Broadband '89, San Francisco.

Brown, F.B (1990). *Bridge across Saskatchewan: Equal access to information for all residents.* Educational and Training Technology International, August, 27(3), p. 305-317.

Brown, F.B. (1989). *Bridging the distance: The Saskatchewan Educational Telecommunications experience.* In Proceedings Pacific Telecommunications Connectivity: Users, Networks and Information Services. Edited by L.S. Harms and Dan J. Wedemeyer,.Honolulu: Pacific Telecommunications Council, p. 453-462.

Brown. F.B., (1990). *Saskatchewan Communications Advanced Network: Distance education Saskatchewan style.* In Proceedings of Pacific Telecommunications: "Weaving the Technological and Social Fabric",.Edited by Dan J. Wedemeyer and Mark D. Lofstrom. Published by the Pacific Telecommunications Council, January, 1990, pp. 548-556.

Fax machines, speaker phones part of Eastend schools. (1989, October). The Leader-Post, p. A7.

Fortosky, D.M. (1984). *"Uplink '84": The University of Saskatchewan broadcasts on ANIK C to the four western provinces..* A paper presented to the Canadian Satellite Users Conference, Ottawa..

Kyle, W.D. (1985). *The response of Saskatchewan residents to a proposal for creation of the Saskatchewan Communications Advanced Network.* Regina, Saskatchewan: Communications Secretariat, Government of Saskatchewan.

Lane, G. (1984). *A proposal for a Saskatchewan Communications Advanced Network (SCAN).* Regina, Saskatchewan: Government of Saskatchewan, Communications Policy Branch.

Lane, G. (1984). *Public asked to respond to SCAN proposal.* News Release. Regina, Saskatchewan: Government of Saskatchewan, Communications Policy Branch.

Saskatchewan Education. (1987). Resource-based learning, policy,guidelines and responsibilities for Saskatchewan learning resource centres. Regina, Saskatchewan: Author.

Satellite system may educate Eastend students. (!989, October). The Shaunavon Standard, 42, p. 1.

SCAN (1989). *Unpublished News Release.* May 29, 1989

Scissons, E. (1984). *Uplink '84 evaluation report.* Saskatoon, Saskatchewan: Division of Extension and Community Relations, University of Saskatchewan.

Staff. (1988, December). SaskTel's video jukebox is "movie-ing" experience. SaskTel News, 29(12), p. 1.

Staff. (1990, February). Rapid access video complements high school curriculum. SaskTel News, 31(2), p. 8.

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The Telcos Are Coming, The Telcos Are Coming: Economic and Cultural Implications for the Pacific Islands

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This study examines the rise of the telco in the U.S. from an economic and regulatory perspective and identifies possibilities and problems with its application in the Pacific Island Nations.

The growth of the information society taking place in the industrialized parts of the world is creating an ever-widening gap between the developed world and the lesser developed countries (LDCs). While the industrialized world continues to place greater emphasis on the economies of the information industries (1), the LDCs remain relatively "technologically backwards." Deregulation and liberalization of the information industries are non-issues. Instead, the LDCs are faced with a lack of a communications infrastructure which, consequently, inhibits the growth of an information economy. Other problems, such as over-population, famine, war, and natural disasters, often confront the LDCs, taking precedence over the evolution of communications systems.

Given such problems, most LDCs approach information and communication from a development perspective, i.e. they are a vital ingredient for economic, political, educational, and social development. The transfer of communications technology, such as the telco, from the modern or industrialized world to the LDCs should be suitable to the LDC's development strategies.

Development is a very open-ended concept. In general, development refers to social change, which can be economic, educational, political, or social in nature. Given this "vagueness," there has been much debate over the success of development communication strategies in the LDCs (2). Most of the debate centers whether development communication promotes modernization and growth or dependency and underdevelopment. Out of these discussions and debates, a new "vision" of development, focusing on basic human needs, has emerged over the past decade. The solutions of development problems are culture-bonded and cannot be transferred form one society to another society which has distinctly different values (3). Culture permeates society, including political, educational, social, and economic realms. Given this notion of culture-bonded development solutions, in any discussion of technology transfer, the software--as well as the hardware--becomes an integral part in terms of programming content. The "media, the message, and the manager should all be aligned to the same objective of self-reliant development" (4).

This study examines the rise of the telco in the U.S. from a regulatory perspective and identifies possibilities and problems with its application in the Pacific Islands Nations. Because of the diversity of telecommunication and communication systems and practices among the Pacific Island Nations (PINs), the infrastructure and services of telcos in the U.S. might provide a viable voice, data, and video communications system model for PINs. This study places particular emphasis on the transfer and application of the telcos video distribution capabilities to the PINs from a development perspective.

Telcos in the United States

The telcos are coming, the telcos are coming. This phrase is both spoken and repeated by the information and communications industries. When will they be here and what services will the provide?

> The inevitability of a telephone company-provided, switched fiber optic transmission path to the home is widely assumed. The only serious debate concerns the timing...(5)

Optical fiber "for communications... now dominates the transmission construction plans of the telecommunications industry" (6). Optical fiber not only enhances voice and data transmission, but provides an infrastructure for video distribution. Indeed, the Regional Holding Companies (RHCs) "expect to be in the video business by the year 2000" (7).

The "telco" represents the movement of telephone companies from traditional voice and data transmissions to an integrated communication network that provides the opportunity to distribute information services and television programming as well as voice and data transmissions. The telco has evolved in the United States as a result of technological development, government legislation, economic forces, and the political philosophy of deregulation.

Given the growing importance of the international marketplace, especially in information and communication activities, there is no reason to expect that telcos will not export new technologies and services beyond the United States. Pacific Telesis has already entered the international marketplace with a joint cable venture (8). Other RHCs have purchased and operate cable systems in Europe and Asia. Their "motivation" has been to gain experience in operating cable as a business opportunity. Almost every RHC has some type of plan to enter the international market (9).

LEGISLATIVE BACKGROUND

Divestiture of AT&T

On November 24, 1974, the U.S. Department of Justice filed suit against AT&T for antitrust violations (10). The suit alleged that AT&T monopolized long-distance services, the market for customer premises terminal equipment, and the market for telecommunications equipment (11). The trial began January 15, 1981, with U.S. District Court Judge Harold H. Greene at the bench. The Justice Department's presentation of evidence began on March 4, 1981 (12). AT&T's presentation of evidence began on August 3, 1981 (13). On January 8, 1982, AT&T and the Justice Department announced a negotiated consent decree that required AT&T to divest its Bell Operating Companies (BOC's) (14). The settlement, commonly called "Modified Final Judgment" (MFJ), was approved by Judge Greene on August 24, 1982, after several modifications (15). In December of 1982 AT&T submitted a reorganization plan to Judge Greene, which he approved on August 5, 1983. The Supreme Court upheld the reorganization plan on December 5, 1983 (16).

The MFJ transferred ownership of the twenty-two BOC's from AT&T to seven Regional Holding Companies (RHC's) and placed business restrictions on AT&T and the RHC's. These restrictions prohibit the RHC's from providing long distance services, manufacturing certain types of equipment, and owning information services that are distributed through phone systems. The MFJ does not specifically identify cable television as an information service. However, most industry observers assume that cable television is a restricted information service (17).

In September of 1987 Judge Greene, who has the responsibility of overseeing the MFJ, ruled that the RHC's could transmit information services. However, Judge Greene refused to lift restrictions that prohibit the RHC's from providing content or having a financial interest in the content (18). On March 7, 1988, Judge Greene issued an order that permitted the RHC's to establish telephone-computer systems that connect an information provider and user together. Also, Judge Greene allowed the RHC's to distribute a limited number of electronic messaging services, such as electronic mail and voice storage and retrieval services (19). These rulings by Judge Greene allowed the RHC's to provide the infrastructure for information services and reinforced ownership and content restrictions contained in the MFJ.

Telco-Cable Cross-Ownership Rules

In 1970 the Federal Communications Commission (FCC) adopted a cross-ownership rule that prohibited telephone companies from operating cable television systems. Telephone companies that were operating cable systems at the time were forced to sell the cable operations. However, there was one exception to this rule. The FCC allowed telephone companies, which were operating cable systems in rural communities that had a low density factor of homes per mile, to request a waiver of the rule (20). In 1981 the FCC adopted a general waiver of the cross-ownership rule for rural telephone-cable operations that met two requirements. First, the rural population that could gain access to the cable system had to be 2,500 or less. Second, the telephone company would have to be the only company interested in providing cable service to the community (21).

The 1970 cross-ownership rule and the 1981 waiver were codified by Congress when it passed the Cable Communications Policy Act of 1984. This legislation, which was incorporated into the Communications Act of 1934 as Title VI, codified the cross-ownership rule by prohibiting telephone companies from providing cable television service in their telephone service area and from having an ownership interest in a cable system that uses the resources of the telephone company to distribute its service.

> (b)(1) It shall be unlawful for any common carrier subject in whole or in part to title II of this Act, to provide video programming directly to subscribers in its telephone service area, either directly or indirectly through an affiliate owned by, operated by, controlled by, or under common control with the common carrier.
>
> (2) It shall be unlawful for

> any common carrier, subject in whole or in part to title II of this Act, to provide channels of communications or pole line conduit space, or other rental arrangements, to any entity which is directly or indirectly owned by, operated by, controlled by, or under common control with such common carrier, if such facilities or arrangements are to be used for, or in connection with, the provision of video programming directly to subscribers in the telephone service area of the common carrier. (22)

The Cable Communications Policy Act of 1934 codified the 1981 waiver by providing an exemption for rural communities.

> (3) This subsection shall not apply to any common carrier to the extent such carrier provides telephone exchange service in any rural area (as defined by the Commission).
> (4) In those areas where the provision of video programming directly to subscribers through a cable system owned by, operated by, controlled by, or affiliated with the common carrier involved, or upon other showing of good cause, the Commission may, on petition for waiver, waive the applicability of paragraphs (1) and (2) of this subsection. (23)

CURRENT REGULATORY ENVIRONMENT

At the present time telephone companies are not permitted entrance into the cable television business or other video information services. These restrictions, which are upheld by Judge Greene and the FCC through its enforcement of Section 613 of the Communications Act of 1934, remain controversial today. Let us briefly examine where Judge Greene, Congress, the FCC, the National Association of Broadcasters, the National Cable Television Association, and the RHC's stand today.

Judge Greene

In April of 1989 AT&T submitted a request to Judge Greene for entry into electronic publishing. The request, which asked for the termination of a seven-year ban in the MFJ, was approved by the Judge and became effective on August 24, 1989 (24). The RHC's, which received no relief in this ruling, wrapped themselves in the First Amendment and moved to the U.S. Court of Appeals in Washington. On December 6, 1989, the RHC's appeared before the court and presented a case that promoted freedom of speech over telephone lines (25). In April of 1990 the court ruled that Judge Greene had been using the wrong standard to prohibit the RHC's from providing information services, such as cable television and electronic yellow pages (26). This ruling, which asked Judge Greene to reconsider his rulings pertaining to information services, did not remove the ban. On August 17 the RHC's filed a response requesting the removal of the information services ban. Comments on this issue by interested parties were submitted on or before October 3. The RHC's had until November 21 to provide responses to the comments (27).

Congress

The U.S. Congress has attempted to shape telecommunications policy while being targeted by political interest groups representing the broadcasting industry, the cable television industry, information providers, the telephone industry, the publishing industry, etc. Bills, such as H.R. 2437 and Swift-Tauke, have introduced legislation to repeal Section 613 of the Communications Act of 1934 or allow the RHC's into the information services market (28). The latest attempt by Congress to remove barriers that eliminate cable-telco cross-ownership restrictions failed. On August 1, 1990, the Senate Commerce Committee adopted S. 2800, which was a substitute to legislation that would have allowed the telephone companies to provide cable services (29). This bill, which is known as the "video-dial tone" bill, maintained the common carrier status of telephone companies.

FCC

On September 28, 1988, the FCC released a Notice of Proposed Rulemaking that proposed that the telco-cable cross-ownership rule be eliminated and that FCC restrictions pertaining to affiliations between telephone companies and cable television providers be modified (30). In December of 1988, a week before comments were due on the proposed rulemaking, the FCC released a report that concluded telephone companies will inevitably enter the cable television marketplace (31). On August 22, 1990, the FCC filed a brief with the U.S. District Court for D.C. (32). In the brief the FCC requested that the information services ban be eliminated.

National Association of Broadcasters

In June of 1989 the NAB Board adopted a policy statement on the entry of telephone companies into broadband services (33).

> The Board (1) called for the development of limitations and and restrictions on the Modified Final Judgment (issued by U.S. District Judge Harold Greene in his supervision of the breakup of AT&T), in the event that there are attempts to relax current restrictions;
> (2) stated its opposition to telephone companies being permitted to own or operate existing cable systems;
> (3) recommended that telephone companies be allowed entry into the home as a second broadband conduit and be regulated as a common carrier;
> (4) opposed telco involvement, in any respect, in content origination. (34)

In January of 1990 the NAB Board reaffirmed this policy statement (35).

National Cable Television Association

The National Cable Television Association (NCTA) has strongly campaigned against the telco's entry into the cable business. The association has primarily attacked the telco's on two fronts. First, the NCTA has argued that telcos have a monopolistic history that could resurface in the form of anticompetitive practices such as cross-subsidization. Second, the NCTA has argued that telco's will significantly alter the operation and value of local television stations. Under this scenario telephone companies would replace the stations as local affiliates, compete with the stations for local and regional advertising dollars, and diminish the value of a station's license (36).

RHC's

The RHC's have consistently supported telco entry into broadband services. To accomplish this goal, the RHC's are pursuing two primary objectives. First, the RHC's are seeking the elimination of the information services ban in the MFJ. If the ban was removed the RHC's could own cable systems outside of their telephone service areas and produce programming that is distributed inside or outside their service area. Second, the RHC's are seeking the elimination of FCC rules which prohibit telco-cable cross-ownership. If the cable-telco cross-ownership rules were eliminated the RHC's could own and operate cable systems inside and outside of their telephone service area. According to the RHC's, this type of market structure would provide cable systems with some much needed competition, provide broadcasters with an alternative delivery system into the home, enhance the information services industry, and thrust more citizens into the information age.

To gain experience in the distribution of video several RHC's, through their "Bell" subsidiaries, have conducted test trials across the United States. One of the current trials is being conducted in Heathrow, Florida.

In September of 1987 Southern Bell announced its participation in a fiber optics project in Heathrow, Florida (37). Southern Bell's responsibility in the project would be the construction of a fiber-to-the-home system designed by Northern Telecom. This transport facility would be leased to Heathrow Communications, a subsidiary of Heathrow Development Company and the local cable franchisee (38). The three partners in the project, Southern Bell, Northern Telecom, and Heathrow Communications, identified the project's ultimate goal as being the development and operation of an integrated services digital network (ISDN) that would have the capability to provide voice, data, and video services.

The installation of the system began in the fourth quarter of 1987. By November of 1988 sixteen homes were receiving ISDN services (39). By September 1990 the number of ISDN equipped homes had increased to 50 (40).

The installation of this digitally-switched system allows viewers to gain access to existing channels and to receive video-on-demand. Switched video over fiber is achieved by sending a signal, from the remote control unit and digital set top converter, upstream over the same fiber that delivers the video signal to the home (41).

Political and Economic Factors

The RHCs have spent thousands of hours and billions of dollars campaigning and preparing for an information age in which they plan to be a dominant player by offering a sophisticated telecommunications system to residential and corporate consumers. Up to this point in time, much of the effort has been in lobbying congress. The telcos have claimed that their participation in the information services and cable television industries will provide an alternative distribution system for broadcasting outlets, create much needed competition against monopoly cable operators, lower the cost of cable programming to suscribers, and thrust a larger section of the American population into the information age.

Underlying their "political" assertions are several economic variables. First, the telcos move to video can be accomplished by using existing resources which can minimize initial capital outlay. The USTA suggests that integrated broadband networks are "cost-effective today for some architectures and may involve only slight additional investment per suscriber. Once fiber is deployed more widely, production economies will bring costs down even faster" (42). Fiber is presently being deployed across the U.S. in place of traditional coaxial cable. At present, there are over 1 million miles of fiber optic cable in the U.S. (43). Indeed, the state of New Jersey has more fiber installed than all of Europe combined (44). Fiber is being deployed and presently used in the head end and trunk portion of telephone systems. Once systems complete the fiberization of the head end and trunk, the telcos need only extend the fiber to the curb or to the home.

Second, the current regulatory environment restricts the profits fo the RHCs in their "primary" service area: residential and business telephone service. The distribution of video allows the telcos entry into a market where profits are not regulated. The RHCs have "analyzed the [cable television] business and think that it is an excellent investment opportunity" (45). The RHCs believe they will capture the "lions share" of the national advertising revenue. One study suggests the RHCs will have gross advertising revenues of $14 billion to $25 billion annually by the year 20032 (46). Given these dollar figures, it is not surprising that telcos are moving into the video marketplace.

Third, the telcos will proved must needed competition to the cable industry. In fact, most industry analysts predict that telco entry will end cable's "natural monopoly" and subsequently lower the cost of video programming to the consumer. In addition, the telcos will facilitate innovation and the distribution of video services such as video on demand and High Definition Television (HDTV) (47).

Fourth, politicians, industry leaders, and the U.S. media have expressed concern over the U.S. position in the international information marketplace. The RHCs have "preyed" upon the fear of America's losing to foreign competitors. One RHC advertising campaign aimed and Congressional legislators stated "If You Like Being Number 2, You'll Love America's Telecommunication Policy" (48). In reality, however, the RHCs position in the international marketplace is not as "bad" as they pretend. Indeed, the RHCs have actively entered foreign markets. Pacific Telesis, for example, holds franchises with partners to build cable television systems that could reach 830,000 homes in Britain. U.S. West holds cable tv franchises in Hong Kong, Britain, and France, and is part of a consortium for a fiber optic cable project in the Soviet Union. Bell South has a cable tv interest in France, while NYNEX has a cable tv interest in Britain and Southwestern Bell has cable tv interests in Britain and Israel (49).

Telcos in the Pacific Islands

The Pacific Island Nations (PINs) represent one of the most diverse regions of the world in terms of politics, languages, governments, and cultures. The islands represent "specks" spread out over 29 million square kilometers of the Pacific Ocean. Physical isolation is a major development obstacle. The Cook Islands, for example, comprise 93 miles of land, spread out over 750,000 square miles of ocean. It is not uncommon for distances of 300 and 400 miles separating islands.

The political entities represent various stages of dependence and independence. There are several independent groups, such as Nauru, Kiribati, Fiji, Western Samoa, and Tonga. Other groups, such as the Marshall Islands, the Cook Islands, and the Federated States of Micronesia, have entered into agreements of free association which allow for self-government with close political affiliation to a former colonial power. Still other groups, such as American Samoa, Pitcairn, Guam, New Caledonia, Wallis and Futuna, remain territorial possessions of the former Pacific colonial powers (50).

The economies of the PINs are not as diverse as the forms of government. Generally, the economies of the PINs are heavily dependent upon one commodity and imports are in excess of exports. Most also rely heavily upon subsistence agriculture and development aid. Indeed, development aid comprised "19.4% of the total revenue for all PINs for 1984-1985 and accounted for anywhere from 2% of GDP for Fiji to 118% of GDP for Tuvalu" (51).

The people, cultures and the requirements of those cultures are as varied as the names suggest. The Mariana Islands and French Polynesia bear little resemblance to one another. Neither do the Marshalls and New Caledonia (52). Given the differences in culture and the vast distances separating island communities, many of the Pacific cultures know little about one another and, in some cases, little about the cultures within their own political entities.

The telcos evolved in the U.S. out of market driven, private enterprise telecommunications system. This is vastly different from the PINS, where most telecommunication systems are operated by state governments, which are not necessarily profit driven. Given these differences, what can the telcos offer the PINs? First, a telco infrastructure can give PINs freedom from a reliance upon international satellite services for providing domestic service. In addition, the telcos provide a technology for development purposes capable of handling technological innovation, which will help to keep the PINs in a competitive marketplace by offering an attractive environment for external investment. the telcos also provide virtually unlimited capacity, rendering the traditional thin and thick route systems obsolete.

There are, however, some concerns about bringing the telcos into PINs. If the solutions to development problems are culture-bonded, the telcos may not be a solution. If implemented, where will the video programming come from? Most PINs are already heavily dependent upon foreign programming and the telco, with its video capacity, may only continue that trend. Another item of concern focuses on the provider of the technology. The telcos require "cutting edge" consumer premise equipment which may easily deteriorate given the Pacific climate. The PINs will remain dependent upon the telco provider for replacement and updated equipment and parts. Another question concerns economics. given most PIN economies, the marketplace will not support a telco system. Most PIN governments are already in budget crises, so the implementation of a telco infrastructure may not be economically feasible, despite its possibilities for economic, education, political, and cultural development.

The telco offers a unique opportunity for PINs to be competitive in the international marketplace. However, given the U.S.-style political and economic guided evolution of the telco, the PINs may find "better" technologies for development opportunities elsewhere.

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(1) See, for example, M. Rubin and E. Taylor, "The Information Sector and GNP: An Input-Output Study," Information Processing and Management, 17 (1981), pp. 163-194, and M.U. Porat, The Information Economy (vol 1 and 2), Washington, D.C.: Department of Commerce, 1976. Porat suggests that as much as 42% of the U.S. GNP emerges from the information sector. Rubin and Taylor suggest that figure is somewhat smaller, around 25%.

(2) For discussions summarizing many of the issues, see Communication Research Trends, vol. 9, #3 (1988/1989); M. Jussawalla and D.M. Lamberton, eds. Communication Economics and Development, New York: Pergamaon, 1981; J. Servaes, "Development Theory and Communication Policy: Power to the People," European Journal of Communication, 1 (1986), 203-229; Robert Stevenson, Communication, Development, and the Third World, New York: Longman, 1988; L. Switzer, "Media Studies and the Critique of Development," Seminar in Contemporary Cultural Studies, #9, (1987), University of Natal, Durban.

(3) G. Hofstede, Culture's Consequences: International Differences in Work-related Values, London: Sage, 1980.

(4) M. Jussawalla, D. Lamberton, and N. Karunaratne, eds. The Cost of Thinking: Information Economies of Ten Pacific Countries, Norwood, NJ: Ablex, 1988, p. 21

(5) Dow, Lohnes, & Albertson, "A Description of Legislative and Judicial Restrictions on Telephone Company Business Plans, An Analysis of Telco Business Acatiavities, And Long Term Planning Considerations for the Broadcast Industry," Policy Memorandum to the NAB, 2 January 1989, Washington, D.C.

(6) Robert Morrow, Manager of Public Information, Southern Bell, personal communication, 25 September 1990.

(7) "Telcos Are Knocking at the Door," Broadcasting 9 April 1990, p. 53.

(8) A. Pearce, "Congressional Input Valuable In Telecom Policy Setting," Network World, 17 July 1989, p. 31.

(9) National Association of Broadcasters, "Telephone Company Market Entry," Background Paper, Washington, D.C.: National Association of Broadcasters, 1989.

(10) B. Enis & T. Sullivan, "The AT&T Settlement: Legal Summary, Economic Analysis, and Marketing Implications," Journal of Marketing, Winter 1985, p. 127; National Association of Broadcasters, 1989, p.3.

(11) Enis & Sullivan, p. 128.

(12) S. Coll, The Deal of the Century: The Breakup of AT&T, New York: Atheneum, 1986, pp. 158 & 173; B. Tunstall, Disconnecting Parties: Managing the Bell System Break-Up, New York: McGraw-Hill, 1985, p. 13; Enis & Sullivan, p. 128.

(13) Enis & Sullivan, p. 128.

(14) Tunstall, p. 16.

(15) Tunstall, p. 42.

(16) Enis & Sullivan, p. 132; Tunstall, p. 86.

(17) National Association of Broadcasters, 1989, p. 5.

(18) "Less Than Half A Load: Judge Greene Refuses to Unleash the Regional Holding Companies," Public Utilities Fortnightly, 15 October 1987, pp. 30-31; P. Huber, "Free Speech for Phone Companies," Forbes, 19 March 1990, p. 172; "Federal Judge Retains Ban on Information Services by BOC's," Broadcasting, 14 September 1987, p. 41.

(19) National Association of Broadcasters, 1989, p. 6; "Videotex:

Rediscovering its niche," Broadcasting, 20 June 1988, p. 72.

(20) National Association of Broadcasters, 1989, p. 6; D. Drialo, "Telephone-Cable Crossownership: Replacing Prohibition," Rural Telecommunications, Winter 1989, p. 55.

(21) Drialo, p. 56.

(22) Drialo, p. 55.

(23) C. Ferris, F. Lloyd & T. Casey, Cable Television Law: A Video Communications Practice Guide--Cable Communications Policy Act of 1984, New York: Mathew Bender Company, 1985, p. 85.

(24) Ferris, Lloyd & Casey, p. 85.

(25) "AT&T Asks Judge to Allow It Into Electronic Publishing," Broadcasting, 1 May 1989, p. 135; "A Boost for the Electronic Press," Fortune, 28 August 1989, p. 14; M. Carnevale & J. Lopez, "In Electronic Publishing, All Eyes Are Fixed on AT&T," The Wall Street Journal, 2 August 1989, p. B1.

(26) Huber, p. 172.

(27) "Court Sends Telco Ban Back to Judge Greene," Broadcasting, 9 April 1990, p. 66.

(28) NYNEX, "Information Services Restriction," Regulatory Update, New York: NYNEX, September 1990.

(29) United States Telephone Association, "Telco/Cable Cross-Ownership," Position Paper, Washington D.C.: United States, 8 May 1990, p. 1; A. Pearce, "Congressional Input Valuable in Telcom Policy-Setting," Network World, 17 July 1989, p. 31.

(30) "'Video-Dial Tone' Bill Approved," Broadcasting, 6 August 1990, p. 72; NYNEX, p. 1; National Association of Broadcasters, "Legal/Regulatory Update", Washington D.C.: National Association of Broadcasters, September 1990, p. 6.

(31) National Association of Broadcasters, 1989, p. 7.

(32) National Association of Broadcasters, 1989, p. 7.

(33) National Association of Broadcasters, 1990, p. 5.

(34) National Association of Broadcasters, 1990, p. 5.

(35) National Association of Broadcasters, 1990, p. 5.

(36) National Association of Broadcasters, 1990, p. 5.

(37) "Telco-TV: Broadcasters' Worst Nightmare," Broadcasting, 11 September 1989, p. 38.

(38) D. Bushaus & D. Pfeiffer, "Fiber to the Home: A Family Affair," Telephony's Transmission Special, November 1989, p. 31.

(39) Shooshan & Jackson Inc., "Broadcasters and Telephone Companies: Risks and Opportunities in a Fiber Future," Position Paper, Washington D.C.: National Association of Broadcasters, 1989, p. 13.

(40) Morrow, personal communication, 25 September 1990.

(41) Northern Telecom, "Northern Telecom Adds Digital Video Over Fiber, Produces Highest Quality Available," Media Release, Atlanta: Northern Telecom, 18 July 1989, p. 2.

(42) USTA, "Telco/Cable Cross Ownership," Position Statement, Washington, D.C.: USTA, 1990.

(43) NAB, p. 20. Other estimates by the NAB suggest that the RHC's have already laid more than 3 million miles of fiber.

(44) NAB, p. 20.

(45) NAB, p. 32.

(46) S. Marshall, "Are Telcos In Our Future," Direct Marketing November 1989, p. 130.

(47) For further discussion of HDTV and the telcos, see: B. Dick and R. Lehtinen, "View From the Top," Broadcast Engineering December 1989, pp. 38-48; J. Whitaker, "HDTV: Politics on a Grand Scale," Broadcast Engineering June 1989, pp. 186-190; and D. Cripps and J. Sawuyer, "Hi-Def In A Decade?," Video December 1988, pp. 80-85+.

(48) "Should the U.S. Free the Baby Bells?," Business Week 12 March 1990, p. 119.

(49) W. Symands, P. Coy, and S. Baker, "The Baby Bells Take Their Show on the Road," Business Week 25 June 1990, pp. 104-105.

(50) For an excellent description of political status among Pacific Island Nations, see Stewart Firth, "Sovereignty and Independence in the Contemporary Pacific," The Contemporary Pacific, 1, #1 and 2 (1989): 75-96.

(51) M. Jussawalla and M. Ogden, "The Pacific Islands: Policy Options for Telecommunications Investment," Telecommunications Policy, vol. 13, #1 (1989): 41.

(52) See, for example, Institute for Polynesian Studies, Proceedings of the 1982 Politics Conference: Evolving Political Cultures in the Pacific Islands. Laie, Hawaii: Bringham University-Hawaii Campus, 1982.

Transpacific-Soviet Telecommunications Project: A Japanese-Soviet-American Educational Partnership

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1. Abstract

June 8, 1990 marked the start of a unique relationship between educators in Japan, the Soviet Union, and Hawaii. On that day a video teleconference took place between schools in Kyushu and Hawaii along with the Moscow School Telecommunications Project. The event launched a multimedia, computer-based educational telecommunication venture to investigate factors necessary for effective, cooperative international educational activities. This paper focuses on the background, developments and current collaborative efforts.

2. INTRODUCTION

2.1 TERMINOLOGY

Multimedia computer-based educational telecommunication (CBET) involves using various modes to transmit text, voice, and/or visual information live (*synchronously*) or stored (*asynchronously*) via computer, telephone, television, satellite, and/or radio. CBET is coming of age due to increasing availability of lower-cost educational technology.[1, 2] In Hawaii, Distance Learning - Technology (DL-T) involves the development of various modes of telecommunication and educational technology to enhance educational opportunities for students and teachers in the public schools of the Hawaii Department of Education.[3]

2.2 TECHNOLOGIES AND TECHNIQUES

With increasing development of asynchronous techniques such as facsimile and international computer networks, educators can coordinate projects even though they are widely-separated, as in the case described in this paper involving the USSR, Japan, and Hawaii. In this way, they can plan for subsequent synchronous communication via audio/videophone, television, or satellite. While new techniques of full-motion, satellite television are spreading, they are quite costly for schools as distant and remote as those of this project. In fact, without cross-linking satellites, no one system could be used for Japan, Hawaii and Moscow.

Through slow-scan (SSTV) or freeze-frame technologies, still images can be exchanged over an ordinary telephone line with compatible transceivers at each end. Colorado Video, Inc. pioneered SSTV and has provided equipment grants to many schools and universities through its Scan Net program.[4] Recently Mitsubishi Lumaphones have been utilized on a similar phone-based approach for less-sophisticated but lower-cost video exchanges involving participants in distant locations.

Satellite use for educational purposes has been possible in the Pacific region for the past twenty years by means of PEACESAT (Pan-Pacific Education and Communication Experiments by Satellite).[5] Despite times of limited funding and support, PEACESAT has become an international symbol and model for grassroots, educational and community service programming. Recent funding by the United States government has allowed PEACESAT to resume and expand its international programming in the Pacific hemisphere.[6]

3. BACKGROUND

3.1 U.S.S.R.

Soviet leaders in science and technology see a fundamental and revolutionary change coming with computers and telecommunications. These are powerful amplifiers of communication with the emergence of a new culture of dialogue. They feel it will enter society not only in science but through the whole educational system.[7]

In USSR telecommunication is currently expanding with a major goal to use it in schools. Educators are interested in trying the American method of student projects using telecommunication techniques in our schools.[8, 9, 10, 11]

During the conferences on new technologies in education held in USSR in 1988[12] and 1990[13] with participation of many foreign scientists, the Soviets came to know more about the use of new technologies in schools of Europe and America. From these events developed helpful contacts. For several years the Soviets have taught computer science in secondary schools and have gained experience in doing it. They now come to telecommunications in preparing for the future.

The Soviet Academy of Sciences has been responsible for much of the leadership in developing the area of educational telecommunication in the USSR. There are various agencies within the Academy working to develop international contacts and cooperative efforts. They co-sponsored the 1988 and 1990 conferences that brought together international experts to meet, exchange information and plan for future projects.

The Academy's MoSTNet, Moscow School Telecommunications Network Project [14] has established Soviet-American educational telecommunications with schools in New York State. They have been undertaking research on a project linking 10 schools in New York with 10 schools in the Moscow area. Using electronic mail and video telephone, they have gained considerable experience in the mixing of asynchronous e-mail with synchronous teleconferencing techniques. The main result of its work is linking together students and teachers in Moscow and New York so that they can undertake joint student projects. A special element of the project is using Lumaphones for student contact "almost in person". MoSTNet is looking for a effective combinations of telecommunication in the whole process of teledialogue.

Petrov is working with the MoSTNet telecommunications center for Moscow schools. He participated in the 1988 conference in Zvenigorod, where he met Southworth and assisted him in translating planning and conference sessions and setting up the first Troisk, Russia to Honolulu, Hawaii Lumaphone teleconference. [15]

Among the main problems for the Soviets are the cultural differences and means to overcome them. An associated issue arising is personal contact of schools taking part in the project. Because many children want to see their friends from abroad "alive" and face-to-face, this has encouraged the development of student exchanges with growing numbers of youth predominantly from the USSR and USA. With the recent declaration that even Soviet Aeroflot travel will require hard currency and thus higher costs for travel, this will likely encourage even more contact via CBET in lieu of travel.

3.2 Hawaii

Hawaii is located in the most isolated place in the world (i.e. further from any major city that anywhere else). Therefore, telecommunication can provide its citizens and particularly students important opportunities for interstate and international communication and interaction.

The PEACESAT Project mentioned above has been a beacon of inspiration for low-cost, transpacific educational communications projects. In the early 1970's PEACESAT provided the stage for a variety of international, multi-media programs developed in Hawaii and other participating sites around the Pacific basin. [16]

The University of Hawaii Laboratory School, as part of the UH College of Education's Curriculum Research and Development Group, has been involved for over a decade in a variety of educational telecommunications projects. They have used PEACESAT for international electronic field trip experiences for their students and those in the Pacific basin since the early 1980's.[17] In the mid 1980's, they provided the model for the establishment of the Hawaii Global TELEclass Project that began as a cooperative venture with the Hawaii Department of Education. [18,19]

The current project is being developed under a grant from the Hitachi/USA Foundation to utilize international telecommunication via the New Jersey Institute of Technology EIES (Electronic Information Exchange System) computer network.[20] The international Network for Education in Science and Technology (NEST) is a cooperative endeavor involving NJIT, Fairleigh Dickinson University, and the University of Hawaii College of Education Curriculum Research and Development Group (CRDG). Howard Kimmel of the NJIT Pre-College Programs and Distance Learning directs the project. It focuses on middle school science activities based on the FAST (Foundational Approaches to Science Teaching) curriculum developed at UH.[21] EIES will be used to exchange and compare data and scientific observations made by the students in the various locations. Nishinippon's Goto participated in a FAST 1 teacher training workshop in July 1990.

3.3 Japan

In 1985 the Nishinippon Junior College High School became one of the first Japanese schools to participate in the TELEclass project. They established a sister school status with the UH Lab School and have begun a new era of multimedia telecommunications.

When Nishinippon Junior College High School Principal Masanori Sugo said "Hello, Russia and Hawaii..." his picture and voice were simultaneously seen and heard in Honolulu and Moscow. That international teleconference took place on June 8, 1990. Local times were 2 p.m. in Japan, 7 p.m. in Honolulu and 8 a.m. the next day in Moscow. The event marked the start of this cooperative, international project.

Included in the Hawaii participation were University of Hawaii Laboratory School Principal Loretta Krause. She said, "We hope in the future students can become friends with one another electronically over the telephone to have wide experience culturally and intellectually." She was joined by Lab School science teacher Mary Gullickson Morfitt, University of Hawaii student Marvin Nakajima, and Kumu Hula Olga Kalama. Kalama opened the program with a blessing in Hawaiian followed by a song accompanied by ukulele. The latter presentations fascinated the several hundred students at the Japan site and the participants in Moscow.

MoSTNet's Alexander Uvarov and Alexander Petrov were in Moscow. Uvarov has stated, regarding such endeavors, "...the basic idea was that the use of new technological means of communication and the direct contacts between common people of different countries will become in the nearest decade the global factors changing the consciousness of the people." [22]

The event, possibility the first videophone simultaneous teleconference between Japan, Moscow and Hawaii, was featured in several newspaper and television news programs that day.

4. FUTURE POSSIBILITIES

This very paper is a product of CBET. The original proposal was created by computer and sent by facsimile to Japan and electronically transmitted via EIES to Moscow. As the paper and conference planning developed, a draft of the paper was entered as an EIES "notebook item" for review and editing by each author. Photos and the video taken in Japan were mailed to Honolulu for possible use in the paper and at the presentation. Lumaphone teleconferences were held on an interim basis between Hawaii and Japan or Hawaii and Moscow as part of other educational teleconferences.

This project, being organized using EIES for planning, could become a model for similar cooperative endeavors in the Pacific basin and around the world. While it is hoped the Japanese and Soviet co-authors will be able to attend PTC '91 in person, back-up plans were made for them to participate via videotelephone teleconference in case they are unable to attend in person. This technique was successfully used by the principal author for PTC presentations by co-authors in 1980 and 1988.

In the coming year it is hoped that Moscow and Japan representatives will be able to visit Hawaii and each other's site to meet in person and plan for student interaction during the Hitachi/FAST project.

The actual exchange of students has already taken place between Hawaii and Japan. It is hoped, pending decisions on Soviet hard currency restrictions, that exchanges with the Soviet participating schools will also be possible.

5. FOOTNOTES

[1] See Southworth, et al., 1981

[2] See Southworth, 1982

[3] See Bannan, 1989

[4] See MacIntosh, 1986

[5] See Kingan, et al., 1990

[6] See Knezek, et al., 1990

[7] See Velikhov, 1987

[8] See Velikhov, 1988

[9] See Monakhov, 1986a

[10] See Monakhov, 1986b

[11] See Southworth, 1988

[12] See "Computers, Education and Children 1988"

[13] See "East-West Seminar in New Technologies in Education" 1990

[14] See Prusakova and Uvarov, 1990

[15] See Southworth, Copen, and Morton, 1989

[16] See Southworth, 1977

[17] See Southworth and Klemm, 1985

[18] See Wollstein, 1986

[19] See Southworth, 1988

[20] See Kimmel, 1989

[21] See "Foundational Approaches in Science Teaching, 1980

[22] See Prusakova and Uvarov, 1990

6. REFERENCES

Bannan, J. and I. Zane, **"Hawaii Department of Education Distance Learning - Technology Program,"** presentation at the EDucators for TEchnology and Computing in Hawaii conference, Honolulu, Hawaii, October 1989.

"Computers, Education, and Children," a conference co-sponsored by the Association for the Development of Computer-Based Instructional Systems (ADCIS) and the USSR Academy of Sciences, Zvenigorod, USSR, October 2-6, 1988.

"East-West Invitational Seminar in New Technologies in Edcuation," Soviet Academy of Science, Institute for New Technologies, and International Society for Educational Technology conference, Karelia, May 17-24, 1990.

Foundational Approaches in Science Teaching (FAST 1, FAST 2, FAST 3), an interdisciplinary, environmental science program which emphasizes concepts and methods of the physical, biological, and earth sciences, developed by the Curriculum Research and Development Group, College of Education, University of Hawaii, 1980.

Kimmel, H., **"The International NEST (Network for Education in Science and Technology),"** Hitachi Foundation Proposal, 1989

Kingan, S., J.Flanigan, G.Knezek, and J.Southworth, **"The Applications Technology Satellite Networks: Twenty Years of Distance Education in the Pacific Basin,"** paper given at World Conference on Computers in Education (WCCE/90), Sydney, Australia, July 1990.

Knezek, G., P.Scannell, G.Jones, L.Mukaida, T.Avegaliog, A. Freese, and J.Haak, **"Pacific Interactive Data Base Network Access: A PEACESAT, PICHTR, University of Hawaii Library Pilot Project,"** Pacific Telecommunications Council Conference, Honolulu, Hawaii, January 1990.

McIntosh, D. K., **"Scan-Net: Freeze Frame Video Networking,"** In Teleconferencing and Electronic Communications V: Applications, Technologies and Human Factors, compiled by L. A. Parker and C.H. Ogren, Madison, Wisconsin: Center for Interactive Programs, 1986, pp. 46-72.

Monakhov, V.M., **"The Content of the Basic Information Science and Computer Technology Course,"** Soviet Education, Vol. 28, No. 10-11, August-September 1986a, pp. 142-156.

________________, **"Computer Literacy for School Pupils: The Psychological and Pedagogical Problems,"** Soviet Education, Vol. 28, No. 10-11, August-September 1986b, pp. 196-212.

Prusakova, A. and A. Uvarov, **"New York State-Moscow School Telecommunications Project: First Year of Experience,"** paper given at World Conference on Computers in Education (WCCE/90), Sydney, Australia, July 1990.

Southworth, J.H., **"Use of Multi-Media Technology in Cross-Cultural Education,"** World Educators Conference, Honolulu, Hawaii, July 1977.

Southworth, J.H., **"Computer-Based Educational Telecommunications (CBET) for Cooperative National and International Learning, Research, and Administrative Activities,"** National Association of Laboratory Schools Conference, Houston, Texas, February 1982.

________________, **"A Model for Distance Education: The Global Hawaii TELEclass Project (Telecommunication Enriches Language Experiences) Past, Present, and Future),"** Toward a Seamless Society: Networking the Education Community, Apple Education Advisory Council: Learning Tomorrow Series, Apple Compuer Inc., Cupertino, California, Winter 1988, pp. 273-294.

________________, **"Multimedia Computer-Based Educational Telecommunication and the Hawaii Global TELEclass Project: A Distance Learning - Technology Model for International Education,"** ADCIS-SAS Conference, Zvenigorod, USSR, October 1988.

________________, P.Copen, and C.Morton, **"Perestroika and Computer-Based Educational Telecommunication: A Soviet View from the Inside,"** Pacific Telecommunications Council Conference, Honolulu, Hawaii, January 1989.

________________, and E.B.Klemm, **"Increasing Global Understanding Through Telecommunications,"** National Association of Secondary Schools Bulletin, April 1985, pp. 39-44.

________________, J.Flanigan, and G.Knezek, **"Computers in Education: International Multi-Mode Node Electronic Conferencing,"** Pacific Telecommunications Council Conference, Honolulu, Hawaii, January 1981.

Velikhov, Y., **"Young Sciences, Young Scientists,"** interview by Izvestia correspondent Kim Smirov, Soviet Life, Febrary 1987, p. 10.

________________, Speech on USSR educational computing and telecommunications, ADCIS-SAS conference, Zvenigorod, USSR, October 5, 1988.

Wollstein, J.D., **"Hawaii Global TELEclass Becomes of Age,"** FLINT Conference sponsored by the Goethe Institute, San Francisco, California, October 1986.

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Alexander Petrov works with the Moscow School Telecommunications Network Project(MoSTNet) Moscow, Russia, USSR. MoSTNet is part of the Soviet Academy of Sciences, which has been pioneering using new technologies the past several years. He has been a leader of electronic telecommunications with MoSTNet and participated in the Education, Computers, and the Child conference in the Soviet Union in 1988 when the first links with Hawaii were developed. Subsequently, he has been involved with a project linking schools in Moscow with schools in New York State.

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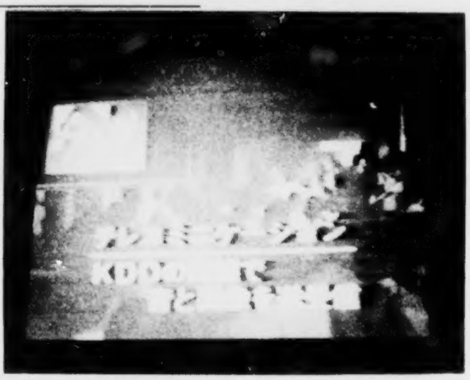
Japan-Hawaii-Moscow

Lumaphone Teleconference

8 June 1990



Above, far left=
Foreground:
Japanese TV news reporter.

Background:
Petrov (Moscow) image on left side of screen.

Above=
Japanese KDD TV news
Left: Honolulu's L. Krause

Right: Nishinippon's M. Sugo

Sending Picture

Lumaphone images
Left: Uvarov (Moscow)

Right: Sugo (Japan)

The Region's Informational Power Index derived from Interregional Communication Flows: Had Tokyo concentrated the domestic informational power during 1975 to 1983 ?

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Abstract. This paper intends to give a factual answer to the question of whether Tokyo has concentrated the domestic informational power in the interregional communication network. Using ratio scale decomposition analysis, we derived the informational power index for each region from the data of interregional communication flows. The derived index characterizes each region's power "position" in the interregional communication network in terms of to what extent the one region informationally depends on the other. The result shows that although Tokyo holds the strongest power, Osaka and Kanagawa also share the significant portions and Ibaraki remarkably strengthens its power in 1980s. We can conclude that the polycentric informational concentration to core regions proceeds in Japan from the viewpoint of interregional communication network.

1. Introduction

The recent remarkable progresses in telecommunication technologies have been arousing the wide concern with the coming information society. Our chief concern in this paper is how these technological progresses would change the interregional communication pattern. One of the important aspects of these technological progresses is, of course, that we can transmit the huge amount of information both at high speed and at low cost. However, we should not look over the other important aspect that these progresses have a character of "network technology". The telecommunication network can be said to have three distinct functions of information transmisson: transparent information transmission, information transmisson with protocol tranformation, and information transmission with semantic processing. The new telecommunication technology is mainly involved with the innovation of the second and the third functions of information transmission. In fact, the new telecommunication technology is often referred to as the network technology that integrates different networks with unifying communication and computation and enables the network to accept and respond simultaneously to the diversified individual demands. Clearly these technological progresses would bring about equalization of each region's relative "position" in the interregional communication network in the sense that differences of locational comparative advantage between regions would decrease in interregional information transactions.

In contrast to these considerations, it has often been argued in Japan that Tokyo has concentrated more and more the domestic information these days, while the coming information society is expected to decentralize its informational structure. That argument, however, lacks the factual basis. Thus, we would like to give a factual answer to the question of whether Tokyo has concentrated its domestic informational power or not. For the purpose, we must need not only the data of interregional communication flows in Japan but also some scale to measure the informational power "position" of each region in the interregional communication network.

Recently, National Land Agency of Japan(1987) published the data of interregional communication flows in Japan at three points of time, 1975, 1980, and 1983, and proposed a regional information power index constructed by a graph theoretical method. As will be seen later, the proposed index, however, is the ordinal scale obtained by ignoring the amount of information flows among regions, so that the proposed index has the defect that we can not compare quantitatively how each region's index has changed between different points of time.

The purpose of this paper is to propose another informational power index for each region to overcome the above defect. Specifically, using ratio scale decomposition analysis(Saito 1989), we derived the informational power index from interregional communication flows. The derived index, which takes into account of the amount of information flows among regions, characterizes each region's informational power "position" in the interregional communication network in the sense of how the one region informationally depends on the other.

2. The framework of the analysis

2. 1 Data

Data used here was published by National Land Agency of Japan in 1987. The data contains the estimated amount of communication flows among 47 prefectures of Japan both through personal media and mass media at three points of time, 1975, 1980, and 1983. We use here that of personal media. Personal media is defined as composed of four means: telephone, data communication, facsimile, and mail. The amount of communication is estimated by summing up each amount of the four means through converting each unit into "word" unit. The regional division of 47 prefectures of Japan is illustrated in Figure 1 and each prefecture's resident population is shown in Table 1.

2. 2 The method employed by National Land Agency of Japan

We here review the method employed by National Land Agency of Japan in order to contrast it with our method of ratio scale decomposition analysis discussed later.

Denote interregional communication flows by a matrix X = (Xij), where Xij means the amount of information transmission from the i-th region to the j-th. Define the input coefficient ratio Qij as the ratio of the amount of information from the i-th region received by the j-th to the total amount of information received by the j-th region, i.e., Qij = Xij/X.j, where X.j = ΣiXij. Let Q = (Qij). Then replacing Qij by 1 if it is greater than the given value (they used 0.05) and 0 otherwise, the matrix Q = (Qij) is transformed into an incidence matrix P = (Pij) whose components are either 1 or 0. They call the sum of the i-th row of the matrix P the Q-level of the i-th region and define the information power index of the i-th region as the Q-level of the i-th region. These are major points of their method of Q-analysis. Interpreting there exists a hierarchical dominating relation from the i-th

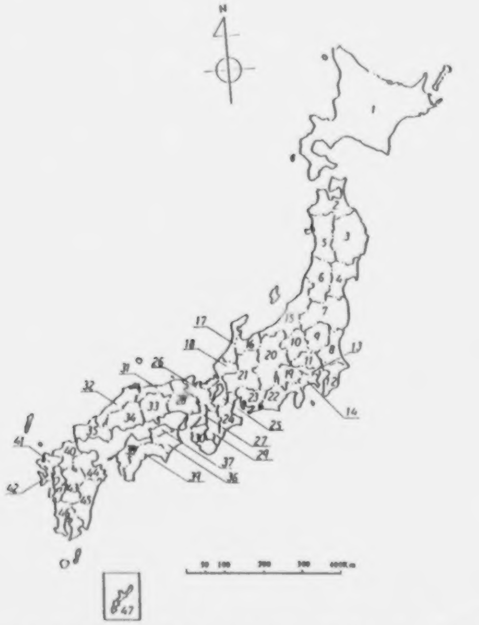

Figure 1. Administrative division of 47 prefectures of Japan (See Table 1 for the names of 47 prefectures)

Table1. Population of Japan and the percentages of 47 prefectures

	1975	1980	1983
Population of Japan (Thousand)	110,945	116,193	118,602
Prefecture's Share (%)			
1 Hokkaido	4.81	4.78	4.76
2 Aomori	1.35	1.33	1.31
3 Iwate	1.27	1.24	1.22
4 Miyagi	1.73	1.77	1.78
5 Akita	1.13	1.10	1.07
6 Yamagata	1.11	1.08	1.06
7 Fukushima	1.78	1.75	1.74
8 Ibaraki	2.11	2.20	2.25
9 Tochigi	1.53	1.54	1.55
10 Gumma	1.59	1.59	1.59
11 Saitama	4.23	4.59	4.74
12 Chiba	3.66	4.02	4.17
13 Tokyo	10.23	9.77	9.64
14 Kanagawa	5.63	5.88	6.01
15 Niigata	2.16	2.11	2.08
16 Toyama	0.97	0.95	0.94
17 Ishikawa	0.96	0.96	0.96
18 Fukui	0.70	0.68	0.68
19 Yamanasi	0.71	0.70	0.69
20 Nagano	1.82	1.79	1.78
21 Gifu	1.68	1.68	1.68
22 Shizuoka	2.98	2.97	2.97
23 Aichi	5.28	5.31	5.28
24 Mie	1.46	1.45	1.46
25 Siga	0.88	0.92	0.94
26 Kyoto	2.17	2.15	2.14
27 Osaka	7.25	7.11	7.06
28 Hyougo	4.43	4.38	4.37
29 Nara	0.96	1.03	1.06
30 Wakayama	0.98	0.94	0.93
31 Tottori	0.53	0.52	0.52
32 Shimane	0.70	0.68	0.67
33 Okayama	1.65	1.62	1.60
34 Hiroshima	2.37	2.34	2.34
35 Yamaguchi	1.39	1.36	1.34
36 Tokushima	0.75	0.72	0.71
37 Kagawa	0.87	0.86	0.85
38 Ehime	1.33	1.31	1.29
39 Kouchi	0.74	0.72	0.71
40 Fukuoka	3.81	3.86	3.88
41 Saga	0.77	0.75	0.74
42 Nagasaki	1.43	1.37	1.35
43 Kumamoto	1.55	1.54	1.53
44 Oita	1.08	1.06	1.05
45 Miyazaki	0.98	0.99	0.99
46 Kagoshima	1.57	1.54	1.53
47 Okinawa	0.95	0.96	0.97

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region to the j-th if Pij=1, they showed the result of Q-analysis as an interesting directed graph, where Q-level was taken as the vertical axis and 47 prefectures as the horizontal axis. (National Land Agency of Japan, 1987, pp114−144)

However, the Q-analysis employed by National Land Agency of Japan has the following defects. First, although, taking Q-level as the vertical axis, they intend to represent the hierarchical linear order relation among regions as a directed graph, the directed graph does not form the linear order since it includes cycles. Only the Q-level forms the linear order relation over regions. Second, we can not quantitatively compare Q-levels at different points of time since they are obtained by ignoring the amount of information transmission. In fact, Tokyo's Q-level, whose maximal value is 47 from its definition, had already assumed 47 in 1975. Therefore, it is meaningless to discuss whether Tokyo had concentrated its Q-level during 1975 through 1983.

2. 3 The method of ratio scale decomposition analysis

In order to overcome the above shortcomings of Q-analysis we wish to propose the ratio scale to measure the region's informational power "position" in the interregional communication network using the ratio scale decomposition analysis.

The ratio scale decomopsition analysis is an extension of Saaty's method (Saaty, 1980) which derives a ratio scale from the outcome of the pairwise comparison carried out by a single decision-maker. In the first place, we briefly explain Satty's method.

Consider a single desicon-maker carries out a pairwise comparison among n objects. He judges n(n−1)/2 pairs in total. When doing a pairwise comparison, he uses a ratio scale he gives on these objects. The ratio scale is unknown to others. After comparing each pair, say, the i-th and the j-th object pair, he records his judgement as a positive real number aij that expresses how much he prefers the i-th object to the j-th. It is arranged in the i-th row and j-th column of an n by n matrix A. The j-th row and i-th column, which is symmetric to the i-th row and j-th column position with respect to the diagonal, is then filled with the reciprocal of aij, i.e., aji=1/aij. We put aii=1. A matrix is called a reciprocal matrix if each element is the reciprocal of its symmetric element. If all its elements are positive, the matrix is said positive. Therefore, the result of his pairwise comparison becomes a positive reciprocal matrix A such that A=(aij), aij>0, and aij=1/aji for i,j=1, . . . ,n. We will call it the outcome matrix for short. His judgement need not be accurate in the sense of consistency.

Saaty considered the problem of how to estimate the decision-maker's ratio scale from the outcome matrix of pairwise comparison. First, suppose a decision-maker having a ratio scale x=(x1, . . . xn) consistently carried out a pairwise comparison. Then the outcome matrix of the pairwise comparison would become a positive reciprocal matrix W such that wij=xi/xj, because the value of accurate comparison of the (i,j) pair must be equal to xi/xj. It is easy to see that rankW=1 and Wx=nx. A positive reciprocal matrix whose rank is 1 is said a consistent matrix. The matrix W is consistent. Moreover, Perron-Frobenius theorem says that n is the maximal eigenvalue of W, which is called Frobenius root, and x is the principal eigenvector corresponding to n. These observations imply that if the decision-maker consistently carries out a pairwise comparison by the unknown ratio scale, we can *reproduce* it as the principal eigenvector of the outcome matrix W.

Generalizing these conceptions to the case where the decison-maker might not be consistent in doing a pairwise comparison, Saaty proposed to *estimate* the decision-maker's ratio scale as the principal eigenvector of the outcome matrix A and to use the consistency index μ to measure how A differs from a consistent matrix. The consistency index μ is defined as $(\lambda(A)-n)/(n-1)$ where $\lambda(A)$ denotes the Frobenius root of the outcome matrix A. These are major points in Saaty's method. We can interpret Saaty's method as an estimation method to estimate the consistent matrix closest to the outcome matrix in terms of principal eigenvectors.

The ratio scale decomposition analysis extends Saaty's method to the group decision problem. Its notion is expressed as the following theorem (Saito, 1989) that shows the method to decompose the ratio scale of the whole group into the contributions of subgroups.

Let us denote by A✱B the elementwise multiplication (the Handmard product) of two matrices A and B, and by A/B the elementwise division of the matrix A by the matrix B. We denote the inner product of two vectors x and y by $<x,\ y>$

Theorem. (Ratio Scale Decompositon Theorem)
Let A and A_k, $k=1,\ldots,s$ be positive reciprocal matrices.

Assume $Aw=\lambda(A)w$, and $A_k x_k=\lambda(A_k)x_k$, where w and x_k are principal eigenvectors of A and A_k for $k=1,\ldots,s$. Denote the i-th component of x_k by x_{ki}. Put $W=(wi/wj)$, and $W_k=(x_{ki}/x_{kj})$ for all $k=1,\ldots,s$.

Define P as $P=A/(W_1*\cdots*W_s)$. Assume $Py=\lambda(P)y$ where y is the principal eigenvector of P. Then,

$$\lambda(A)=\lambda(P) \text{ and } A(x_1*\cdots*x_s*y)=\lambda(P)(x_1*\cdots*x_s*y). \quad (1)$$

Consider two cases: (a)$A=A_1*\cdots*A_s$ and (b)$A\neq A_1*\cdots*A_s$. If $A=A_1*\cdots*A_s$, then the normalized w can be decomposed as follows.

$$w=\langle x_1*\cdots*x_s,\ y\rangle^{-1}(x_1*\cdots*x_s*y) \quad (2)$$

or $$w=\bar{x}_1*\cdots*\bar{x}_s*\bar{y}, \quad (3)$$

where $\bar{x}_k$ is defined as $\bar{x}_{ki}=x_{ki}/<x_1*\cdots*x_s,y>^{1/(s+1)}$ for all $i=1,\ldots,n$ and for each k, and $\bar{y}$ as $\bar{y}i=y_i/\langle x_1*\cdots*x_s,\ y\rangle^{1/(s+1)}$ for all $i=1,\ldots,n$.

If $A\neq A_1*\cdots*A_s$, then the normalized w can be decomposed as follows.

$$w=\bar{w}+(w-\bar{w})=(\bar{x}_1*\cdots*\bar{x}_s)+(w-\bar{w}), \quad (4)$$

where $\bar{w}=(\bar{x}_1*\cdots*\bar{x}_s)$ and $\bar{x}_k$ is defined as $\bar{x}_{ki}=x_{ki}^{1/s}$ for all $i=1,\ldots,n$.

The proof is given in Saito(1989). We interpret the matrix A as the outcome matrix of the pairwise comparison carried out by the whole group and matrices A_k, $k=1,\ldots,s$ as those by subgroups. Both of the decomposition fromulas of (3) and (4) are called ratio scale decomposition. They express how the whole group's ratio scale w is decomposed into subgroups' contributions $\bar{w}$.

2. 4 The region's informational power index constructed by the ratio scale decomposition method

We are now ready to apply the ratio scale decomposition theorem to the data of interregional communication flows. For the purpose, we read the t-th subgroup in the theorem as the t-th point of time. Denote the interregional communication flow at the t-th point of time by the matrix (Xij(t)). Define the input coefficient matrix (Qij(t)) at the t-th point of time as

$Qij(t)=Xij(t)/\Sigma_i Xij(t)$.

We construct $A_1,\ldots,A_s$ from Qij(t) as follows:

$$A_t=((Qij(t)+0.005)/(Qji(t)+0.005)),\ t=1,\ldots,s \quad (5)$$

Here we added 0.005 because the matrix (Qij(t)) has random zeros.[1]

Define the total amount of information flows from the i-th region to the j-th during all the periods as $Xij=\Sigma_t Xij(t)$ and its input coefficient as $Qij=Xij/\Sigma_i Xij$. The matrix A is similarly constructed from Qij.

$$A=((Qij+0.005)/(Qij+0.005)). \quad (6)$$

Now applying the above theorem to these positive reciprocal matrices A and A_t, t=1,...,s, we define the region's informational power index as the principal eigenvectors of A_t, t=1,...,s. The i-th region's informational power index at the t-th point of time is defined as the i-th coordinate of the principal eigenvector of the matrix A_t.

From the definition, the derived index becomes the ratio scale such that the greater the ratio of Qij to Qji, the larger the value of the i-th region's informational power index. In contrast to the Q-level, our index as a ratio scale takes into account the amount of information flows among regions and thus enables us to investigate its chronological change quantitatively. It should also be noticed that the problem that the directed graph obtained by Q-analysis includes cycles is now reduced to the estimation problem to construct the positive consistent matrix closest to the inconsistent outcome matrix. Suppose there exists the information flow such as the region A→B→C. If we consider the information flow as a dominating relation among regions, we should give the larger value to the informational index of the region A than that of the region B and also the larger value to the region B than to the region C. We have constructed the region's informational power index as the ratio scale which forms a linear order relation preserving most closely these directions of information flows among regions. The derived index can be considered a measure taking into account not only the amount of information flows among regions but also each region's relative power position in the interregional communication network.

In the following analyses, we consider three methods to construct the positive reciprocal matrix A_t, and for each case we derive the region's informational power index and investigate its chronological changes. The three methods are (a) the case where we use the matrices of original data of interregional communication flows, (b) the case using the above input coefficient matrices, and (c) the case using per capita input coefficient matrices which are obtained by transforming the amount of information flows into that of per capita information flows.

3. The region's informational power index derived from interregional information flows

3. 1 Method

Now let Xij(t) be the amount of information flows measured by one million word unit from the i-th

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prefecture to the j-th at the t-th point in time. Define A_t and A as follows:

$$A_t = ((X_{ij}(t)+0.5)/(X_{ji}(t)+0.5)),\ i,j=1,\ldots,47,\ t=1,2,3, \quad (7)$$

$$A = ((X_{ij}+0.5)/(X_{ji}+0.5)), \quad i,j=1,\ldots,47, \quad (8)$$

where Xij is the sum of Xij(t) over t from 1 to 3. Here we put Xij(t) = 0 if it is less than 0.1 per cent of total amount of information flows, i.e., $\Sigma_{ij}X_{ij}(t)$. Since it is clear that $A \neq A_1 * A_2 * A_3$, we employ the decomposition formula of (4).

3. 1 Results

The results of the analysis are shown in Table 2 and in Figure 2. In Figure 2, the profile of the informational power index at each point of time is drawn, arranging 47 prefectures as the horizontal axis. Figure 2(a) shows the whole shape and Figure 2(b) is the enlargement of the clustered part in Figure 2(a).

Table 2. Ratio scale decomposition analysis of the data matrix of the amount of interregional information flows

	Year	1975	1980	1983	Residuals	All years	Multiple product	
	Frobenius root	48.64	49.74	49.93	49.95	49.95		
	Consistency index	0.04	0.06	0.06	0.06	0.06		
	Eigenvector	X1	X2	X3	[illegible]	W	$\tilde{W}$	W - $\tilde{W}$
1	Hokkaido	1.97	1.76	1.74	2.46	1.76	1.83	-0.07
2	Aomori	1.98	1.87	1.85	2.32	1.86	1.90	-0.04
3	Iwate	2.06	1.90	1.89	2.26	1.97	1.95	0.02
4	Miyagi	1.98	1.89	1.83	2.30	1.86	1.90	-0.04
5	Akita	2.03	2.22	2.39	1.80	2.28	2.21	0.07
6	Yamagata	1.98	1.89	1.89	2.24	1.87	1.92	-0.05
7	Fukushima	2.40	2.06	2.13	1.72	2.13	2.20	-0.07
8	Ibaraki	2.49	3.29	3.39	1.01	3.31	3.04	0.27
9	Tochigi	1.91	1.76	1.74	2.56	1.76	1.81	-0.05
10	Gunma	2.03	1.88	1.86	2.27	1.91	1.93	-0.02
11	Saitama	2.04	1.90	1.93	2.18	1.95	1.97	-0.02
12	Chiba	2.02	1.90	1.89	2.22	1.89	1.94	-0.05
13	Tokyo	4.65	6.66	6.81	0.25	6.33	5.97	0.36
14	Kanagawa	2.55	3.22	3.27	0.99	3.13	3.00	0.13
15	Niigata	2.03	2.09	1.92	2.05	1.96	2.01	-0.05
16	Toyama	1.95	1.71	1.68	2.62	1.72	1.78	-0.06
17	Ishikawa	1.92	1.78	1.77	2.47	1.76	1.83	-0.07
18	Fukui	1.95	1.98	2.01	2.13	1.94	1.98	-0.04
19	Yamanasi	1.99	1.87	1.86	2.29	1.88	1.91	-0.03
20	Nagano	1.93	1.90	1.90	2.29	1.88	1.92	-0.04
21	Gifu	1.93	1.81	1.79	2.46	1.80	1.84	-0.04
22	Shizuoka	2.02	1.97	1.99	2.12	1.98	2.00	-0.02
23	Aichi	1.97	1.85	1.83	2.35	1.85	1.89	-0.04
24	Mie	2.01	1.89	1.88	2.24	1.89	1.93	-0.04
25	Siga	2.12	2.35	2.24	1.68	2.21	2.24	-0.04
26	Kyoto	2.11	1.95	1.92	2.13	1.97	2.00	-0.03
27	Osaka	3.72	5.10	5.37	0.42	5.08	4.68	-0.03
28	Hyougo	2.14	1.92	1.91	2.16	1.99	1.99	0.40
29	Nara	2.15	1.84	1.81	2.41	2.03	1.93	0.00
30	Wakayama	1.97	1.88	1.85	2.31	1.87	1.90	0.10
31	Tottori	1.86	1.80	1.77	2.51	1.75	1.81	-0.03
32	Shimane	1.86	1.79	1.77	2.53	1.76	1.81	-0.06
33	Okayama	2.02	1.82	1.81	2.39	1.88	1.89	-0.05
34	Hiroshima	2.07	2.27	2.29	1.74	2.21	2.21	0.01
35	Yamaguchi	2.20	1.86	1.84	2.25	1.99	1.96	0.00
36	Tokushima	2.12	1.85	1.83	2.40	2.03	1.93	0.03
37	Kagawa	1.93	1.82	1.78	2.46	1.81	1.85	0.10
38	Ehime	2.07	2.00	2.00	2.02	1.99	2.03	-0.04
39	Kouchi	2.02	1.80	1.78	2.50	1.91	1.87	-0.04
40	Fukuoka	2.05	1.99	2.03	2.04	1.99	2.03	0.04
41	Saga	2.00	1.84	1.82	2.33	1.84	1.89	-0.04
42	Nagasaki	1.97	1.86	1.85	2.33	1.87	1.90	[illegible]
43	Kumamoto	1.91	1.76	1.74	2.56	1.76	1.81	[illegible]
44	Oita	2.03	1.91	1.79	2.23	1.83	1.92	[illegible]
45	Miyazaki	1.87	1.76	1.77	2.56	1.76	1.81	-0.05
46	Kagoshima	1.98	1.87	1.86	2.29	1.86	1.91	[illegible]
47	Okinawa	2.06	1.92	1.91	2.16	1.92	1.97	[illegible]

Figure 2. The profile of informational power index by the original data matrix

Figure 2(a) The whole profile

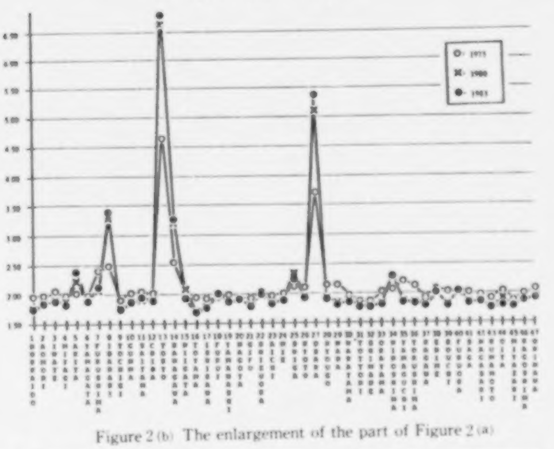
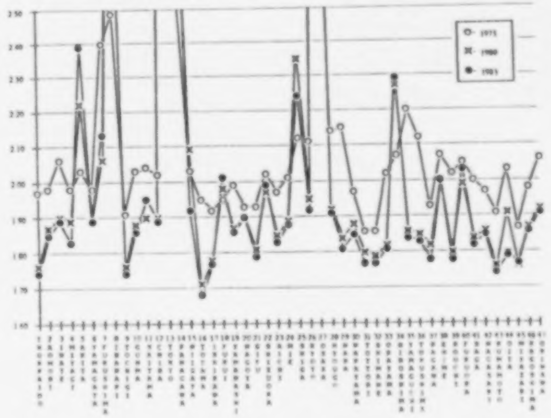


Figure 2(b) The enlargement of the part of Figure 2(a)



From Figure 2(a), it is known that the regions which form peaks on the profile are four prefectures: in turn, Tokyo, Osaka, Ibaraki, and Kanagawa. They all have increased their informational power index from 1975 to 1983. The average of the indices of 47 prefecures is 2.1 (=100/47) because of normalization of their sum to 100. Tokyo's informational power is 3.2 times of the average, Osaka's 2.5 times, and Ibaraki's and Kanagawa's 1.5 times. Other regions' indices are clustering around the average value. Looking at Figure 2(b), it can be seen that almost all the regions except the above four regions have decreased their informational power indices in 1980s because the above four regions have increased their power. Among them, Akita, Fukui, Shiga, and Hiroshima only have increase their informational power in 1980s. From these resuts, we have known that although Tokyo holds the strongest informational power, Osaka and Kanagawa also share the significant portions and Ibaraki

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has remarkably strengthened its informational power in 1980s. Table 3 shows the correlation coefficient between prefecture's population and its informational power index.

Table 3. The correlation coefficient between region's population and the power index derived from interregional information flows

Correlation coefficient	Informational power index 1975	1980	1983
Population 1975	0.783	0.776	0.777
1980	0.761	0.755	0.757
1983	0.753	0.748	0.750

It is a surprising fact that the derived index is strongly correlated to the population. Because it implies the derived index recovers the population only from the data of interregional communication flows. By contrast, the traditional approach like the gravity model is trying to explain the amount of information flows X_{ij} by the populations of the i-th and the j-th regions. If we assume the gravity model such that X_{ij} is proportional to the product of the populations of the i-th and the j-th regions, the term of this product must vanish from A_t because of its definition. Thus why its principal eigenvector recovers populations of regions is an interesting theoretical problem left for the further investigation.

4. The region's informational power index derived from the input coefficient matrices of interregional information flows

4. 1 Method

Now we use input coefficient matrices $(Q_{ij}(t))$ to construct the positive reciprocal matrices A_t. The method is the same as stated in the formulas of (5) and (6) except that here we compute the input coefficients ignoring the diagonal elements of the data matrices $(X_{ij}(t))$ of the amount of information flows among regions. From the theoretical result (Saito(1989), p.6 Theorem 1), the principal eigenvector derived here becomes the elementwise product of the principal eigenvector of the last section and the vector the i-th coordinate of which is the total amount of information received by the i-th region.

4. 2 Results

The results are shown in Table 4 and Figure 3 in the same way as before. Looking at Figure 3(a), we see Tokyo, Osaka, and Kanagawa have still strongly concentrated their informational powers though the concentraion to Ibaraki becomes not so distinctive. We can also see small peaks at several regions such as Fukuoka, Hiroshima and Aichi, which are core prefectures for their local regional bloc. More clearly can we see this in Figure 3(b). However, the chronological changes of informational power indices of these prefetures are not similar. Fukuoka and Ibaraki have increased their powers a little while other core prefectures such as Hokkaido, Miyagi, Aichi and Hiroshima have decreased their powers.

Table 4. Ratio scale decomposition analysis of the input coefficient matrix

	Year	1975	1980	1983	Residuals	All years	Multiple product	
	Frobenius root	49.56	50.86	51.03	50.64	50.64		
	Consistency index	0.06	0.08	0.09	0.08	0.08		
	Eigenvector	X1	X2	X3	Y	W	Ŵ	W - Ŵ
1	Hokkaido	1.82	1.58	1.59	0.67	1.64	1.67	-0.03
2	Aomori	0.77	0.69	0.68	3.60	0.69	0.71	-0.02
3	Iwate	0.84	0.78	0.78	2.88	0.79	0.80	0.02
4	Miyagi	1.27	1.14	1.10	1.35	1.14	1.17	-0.03
5	Akita	0.80	0.79	0.83	2.85	0.81	0.81	-0.01
6	Yamagata	0.79	0.69	0.67	3.53	0.69	0.72	-0.03
7	Fukushima	1.05	0.92	0.88	2.02	0.92	0.95	-0.03
8	Ibaraki	1.53	1.64	1.68	0.74	1.66	1.62	0.04
9	Tochigi	1.15	0.97	0.95	1.75	0.99	1.02	0.04
10	Gunma	1.04	0.85	0.83	2.20	0.87	0.91	-0.04
11	Saitama	2.23	1.48	1.49	0.61	1.58	1.71	-0.12
12	Chiba	1.96	1.50	1.50	0.67	1.57	1.65	0.08
13	Tokyo	26.04	29.00	29.18	0.00	28.62	28.15	0.47
14	Kanagawa	6.77	8.42	8.31	0.03	8.15	7.82	0.33
15	Niigata	1.14	1.14	1.08	1.48	1.11	1.13	-0.02
16	Toyama	0.93	0.79	0.78	2.66	0.81	0.83	-0.03
17	Ishikawa	0.92	0.77	0.80	2.67	0.80	0.83	-0.03
18	Fukui	0.81	0.76	0.78	3.02	0.78	0.79	-0.01
19	Yamanasi	0.87	0.70	0.70	3.17	0.72	0.75	-0.04
20	Nagano	0.94	0.78	0.80	2.57	0.81	0.84	0.03
21	Gifu	1.12	0.80	0.76	2.26	0.82	0.88	-0.06
22	Shizuoka	1.88	1.61	1.62	0.64	1.66	1.70	-0.05
23	Aichi	3.08	2.28	2.24	0.29	2.40	2.52	-0.12
24	Mie	1.01	0.89	0.88	2.16	0.90	0.93	-0.03
25	Siga	1.09	0.98	0.93	1.83	0.97	1.00	-0.04
26	Kyoto	2.07	1.46	1.33	0.69	1.49	1.60	-0.11
27	Osaka	14.34	17.65	18.02	0.01	17.41	16.65	0.76
28	Hyougo	2.85	2.05	1.99	0.35	2.14	2.27	-0.14
29	Nara	1.00	0.78	0.75	2.54	0.79	0.84	-0.05
30	Wakayama	0.92	0.81	0.81	2.58	0.82	0.85	-0.02
31	Tottori	0.68	0.66	0.65	4.17	0.65	0.67	-0.02
32	Shimane	0.75	0.73	0.72	3.46	0.73	0.74	-0.01
33	Okayama	1.25	1.00	0.96	1.59	1.02	1.07	-0.05
34	Hiroshima	1.84	1.47	1.50	0.71	1.53	1.60	-0.07
35	Yamaguchi	1.21	0.89	0.86	1.88	0.93	0.98	0.05
36	Tokushima	0.77	0.74	0.72	3.38	0.73	0.74	-0.01
37	Kagawa	1.03	0.91	0.88	2.08	0.91	0.94	-0.03
38	Ehime	0.93	0.84	0.84	2.40	0.85	0.88	-0.03
39	Kouchi	0.71	0.68	0.68	3.92	0.68	0.69	-0.01
40	Fukuoka	2.33	2.23	2.34	0.36	2.30	2.31	-0.01
41	Saga	0.81	0.70	0.68	3.42	0.70	0.73	-0.03
42	Nagasaki	0.85	0.80	0.80	2.78	0.81	0.82	-0.01
43	Kumamoto	0.96	0.87	0.85	2.32	0.88	0.90	-0.02
44	Oita	0.85	0.75	0.74	3.01	0.76	0.78	-0.03
45	Miyazaki	0.72	0.74	0.73	3.54	0.73	0.73	0.00
46	Kagoshima	0.78	0.75	0.73	3.28	0.74	0.75	-0.01
47	Okinawa	0.54	0.58	0.59	5.91	0.57	0.57	0.00

In Table 5 we show the correlation coefficients of the region's population and the index derived here. Their correlation has much increased than before.

Table 5. The correlation coefficient between region's population and the power index derived from input coefficient matrix

Correlation coefficient	Informational power index 1975	1980	1983
Population 1975	0.855	0.837	0.837
1980	0.834	0.816	0.815
1983	0.826	0.808	0.807

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Figure 3. The profile of the region's informational index by the input coefficient matrix

Figure 3 (a) The whole profile

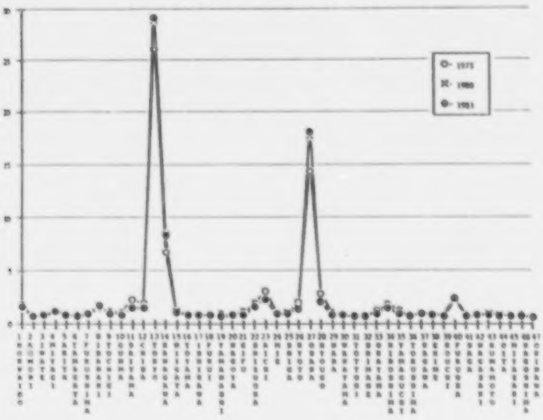
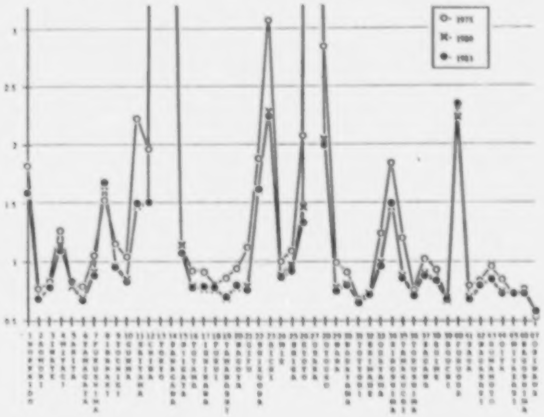


Figure 3 (b) The enlargement of the part of Figure 3 (a)



5. The region's informational power index derived from per capita input coefficient matrices of interregional information flows

5. 1 Method

Here we use per capita input coefficient matrices to construct A_t. Let POPi(t) be the population of the i-th region at the t-th point of time. Define the matrix (Yij(t)) of the per capita amount of information flows among regions as follows.

$$Yij(t)=Xij(t)/(POPi(t)\cdot POPj(t)),\ i,j=1,\dots,47,\ t=1,2,3. \quad (9)$$

We denote the sum of Yij(t) over t by Yij. Let the input coefficient matrix for (Yij(t)) and (Yij) be (Rij(t)) and (Rij) respectively. The positive reciprocal matrices A_t and A are constructed in the same way as before.

$$A_t=((Rij(t)+0.05)/(Rij(t)+0.05)),\ t=1,2,3. \quad (10)$$

$$A=((Rij+0.05)/(Rij+0.05)) \quad (11)$$

5. 2 Results

The results are shown in Table 6 and Figure 4.

To look at Figure 4(a), the profile of the informational power index might seem to be the same as shown before, but a closer look at Figure 4(b) suggests the distinctive characteristics of the chronological change of the per capita informational power index. In spite of removing the effect of population size to transform the amount of information flows into the per capita amount, Tokyo, Osaka, and Kanagawa still show the strong tendency to have been increasing their informational powers and Ibaraki prefecuture has considerably strengthened its informational power in 1980s. Most of other perfectures except a few such as Hokkaido, Niigata, Sizuoka, and Miyazaki have decreased relatively their informational powers in 1980s.

Figure 4. The profile of the region's informational power index by the per capita input coefficient matrix

Figure 4 (a) The whole profile

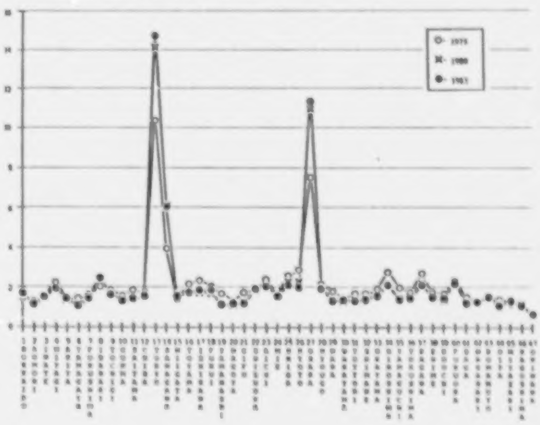


Figure 4 (b) The enlargement of the part of Figure 4 (a)

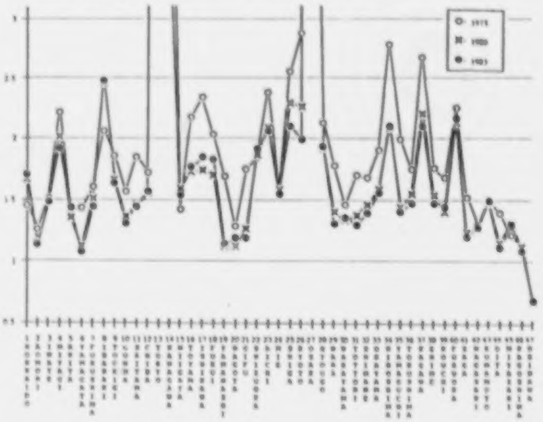


Table 6. Ratio scale decomposition analysis of the per capita input coefficient matrix

	Year	1975	1980	1983	Residuals	All years	Multiple product	
	Frobenius root	49.09	49.86	50.00	49.66	49.66		
	Consistensy index	0.05	0.06	0.07	0.06	0.06		
	Eigenvector	X1	X2	X3	Y	W	$\hat{W}$	$W - \hat{W}$
1	Hokkaido	1.45	1.67	1.70	2.05	1.69	1.61	0.07
2	Aomori	1.26	1.14	1.13	3.54	1.15	1.19	-0.03
3	Iwate	1.51	1.48	1.48	2.24	1.48	1.50	-0.02
4	Miyagi	2.22	2.02	1.92	1.17	2.01	2.06	-0.05
5	Akita	1.42	1.36	1.44	2.54	1.40	1.41	-0.02
6	Yamagata	1.43	1.12	1.07	3.34	1.15	1.21	-0.06
7	Fukushima	1.60	1.51	1.44	2.13	1.50	1.53	-0.03
8	Ibaraki	2.07	2.46	2.48	0.97	2.43	2.35	0.09
9	Tochigi	1.86	1.66	1.64	1.68	1.69	1.73	-0.03
10	Gunma	1.57	1.36	1.31	2.46	1.37	1.42	-0.05
11	Saitama	1.85	1.45	1.45	1.96	1.51	1.58	-0.07
12	Chiba	1.72	1.55	1.56	1.90	1.59	1.62	-0.03
13	Tokyo	10.39	14.12	14.77	0.03	13.78	13.03	0.75
14	Kanagawa	3.93	6.07	6.02	0.20	5.62	5.27	0.34
15	Niigata	1.42	1.59	1.54	2.21	1.54	1.53	0.01
16	Toyama	2.18	1.74	1.77	1.38	1.85	1.90	-0.05
17	Ishikawa	2.34	1.74	1.85	1.26	1.90	1.97	-0.08
18	Fukui	2.03	1.70	1.83	1.44	1.82	1.86	-0.04
19	Yamanasi	1.69	1.12	1.14	2.86	1.23	1.30	-0.07
20	Nagano	1.29	1.12	1.19	3.43	1.17	1.21	-0.03
21	Gifu	1.75	1.27	1.19	2.51	1.33	1.39	-0.07
22	Shizuoka	1.85	1.87	1.92	1.44	1.90	1.89	0.01
23	Aichi	2.39	2.09	2.06	1.05	2.15	2.19	-0.04
24	Mie	1.57	1.59	1.55	2.04	1.58	1.58	-0.01
25	Siga	2.56	2.29	2.10	0.92	2.25	2.32	-0.08
26	Kyoto	2.87	2.26	1.99	0.87	2.25	2.37	-0.11
27	Osaka	7.50	10.99	11.32	0.06	10.48	9.84	0.64
28	Hyougo	2.13	1.93	1.93	1.25	1.99	2.01	-0.02
29	Nara	1.78	1.40	1.30	2.19	1.42	1.49	-0.07
30	Wakayama	1.46	1.34	1.36	2.59	1.37	1.40	-0.02
31	Tottori	1.70	1.38	1.30	2.29	1.38	1.46	-0.07
32	Shimane	1.68	1.46	1.40	2.14	1.46	1.52	-0.06
33	Okayama	1.91	1.59	1.56	1.72	1.62	1.69	-0.07
34	Hiroshima	2.78	2.09	2.10	0.91	2.21	2.32	-0.11
35	Yamaguchi	1.99	1.44	1.40	1.91	1.54	1.60	-0.07
36	Tokushima	1.75	1.55	1.47	1.95	1.55	1.60	-0.05
37	Kagawa	2.67	2.21	2.10	0.90	2.24	2.33	-0.09
38	Ehime	1.76	1.54	1.48	1.93	1.54	1.60	-0.06
39	Kouchi	1.68	1.41	1.44	2.15	1.46	1.52	-0.05
40	Fukuoka	2.26	2.13	2.17	1.04	2.16	2.20	-0.03
41	Saga	1.52	1.24	1.20	2.79	1.26	1.32	-0.06
42	Nagasaki	1.29	1.27	1.27	3.05	1.28	1.29	-0.01
43	Kumamoto	1.50	1.49	1.49	2.27	1.50	1.50	0.00
44	Oita	1.39	1.15	1.11	3.29	1.17	1.22	-0.05
45	Miyazaki	1.22	1.30	1.30	3.12	1.28	1.28	0.00
46	Kagoshima	1.14	1.12	1.09	4.00	1.10	1.12	-0.02
47	Okinawa	0.67	0.67	0.69	10.85	0.67	0.68	-0.01

Table 7. The correlation coefficient between region's population and the power index derived from per capita input coefficient matrix

Correlation coefficient	Informational power index 1975	1980	1983
Population 1975	0.799	0.824	0.825
1980	0.778	0.804	0.805
1983	0.770	0.797	0.797

In the same way as before, we show in Table 7 the correlation coefficient matrix between the informational power index and the population. Looking through each column of the matrix from top downward, we can see the correlation coefficient between the population and the informational power index decreases as time goes on. This observation also hold true for the previous two tables. It might imply that the informational power structure of interregional communication network tends to be free from the regional population distribution.

6. Conclusion

Our purposes of his paper were twofolds. One was to give a factual answer to the question of whether Tokyo has concentrated the domestic informational power in a monocentric fashion. In order to do so, we set out the other purpose to develop some scale to measure each region's relative power position in the interregional communication network.

For the latter purpose, using ratio scale decomposition analysis, we have derived the region's informational power index from interregional communication flows. We have shown that the derived index characterizes each region's power "position" in the interregional communication network in terms of to what extent the one region informationally depends on the other.

For the former purpose, we have analyzed the choronological changes of the derived index of region's informational power. The results of the analyses show that although Tokyo holds the strongest informational power, Osaka and Kanagawa also share the significant portions and Ibaraki has remarkably strengthened its informational power in 1980s. We can conclude that the concentration of informational power in Japan is not the monocentric one to Tokyo but the polycentric concentration to several core regions.

Notes

1) We followed the method of Goodman (1970) to deal with random zeros in contingency table analysis. Since we here deal with the input coefficient matrices, adding 0.005 removes singular effects of input coefficients which are very small relative to 0.5%.

References

[1] National Land Agency of Japan (1987) *Regional Information Power*, (in Japanese) Printing Office of Ministry of Finance

[2] Goodman, L. (1970) "The multivariate analysis of qualitative data: interactions among multiple classifications" *Journal of American Statistical Association* 65 226-256

[3] Satty, T.L. (1980) *The Analytic Hierarchy Process*, McGraw-Hill

[4] Saito, S. (1989) "Ratio Scale Decomposition Analysis of Group Preference", paper presented at TIMS XXIX at Osaka '89; revised in Discussion Paper 7, Faculty of Economics, Fukuoka University, Fukuoka, Japan, available from the author.

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Access to Decision-Making about Communications: Form and Substance in the Australian Experience

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Abstract

There is range of opportunities for access to decision-making about electronic communications in Australia. Most important decisions are made by the elected government rather than by AUSTEL or the Australian Broadcasting Tribunal. Some local experience of procedures and processes is comparable with that of other countries, but only if constitutional differences are taken into account. Decision-making processes affect the quality of decisions ultimately reached. It is important to get the right process with the right level of access, particularly having regard to the level of policy which a decision involves.

I. Why the processes matter(1)

The decision-making process determines the direction and success of communications laws and policies. It is convenient, and fashionable, to speak of the communications regimes prevailing in various nations in a static manner. Governments announce that they have 'liberalised' one area of communications, that they have 'streamlined' another, or that they have provided 'safeguards' in another. Such labels can sometimes be accurate and useful, but they do not tell us what will actually happen. They simply announce an intended official direction. It is a rare thing to find a new law or policy which is self-executing, in the sense that it does more than offer signposts to decisionmakers at some level in the system, private or public, about what a government wishes to achieve.

The decision-making process receives surprisingly little attention in the vigorous national and international discussions currently taking place about communications policy. Often, policy appears to proceed on the basis that there are no limits to the legislator's ability to dictate the future. Part of the explanation may lie in the current rapid rate of change. We are experiencing the birth of many new policies; and optimism prevails at birth. Thus, it is assumed that the complexity and failure involved with middle aged or old policies, whose performance can be judged, were the result of bad policies. In fact, many of the now discredited policies may have been good ones which failed only because there were no suitable means for implementing them. It is also possible that the North-Atlantic view of human society is part of the problem. Much North American and European writing about communications appears mechanistic, whatever the viewpoint expressed. It may be that successes in the physical sciences have led to high expectations in the social sciences that economic and social behaviour follow relatively simple laws. Once we identify these laws, it is apparently assumed, we can dictate results in society and the marketplace as readily as we can dictate the number and design of widgets.

Even the terminology which one might use to criticise the mechanistic approach embodies the very problem one would seek to diminish. It could be said that the models or paradigms are oversimplified. But the very concept of a 'model' or a 'paradigm' implies the acceptability of reducing social and political institutions to some kind of quantifiable, predictable or consistent representation. The point is that essential parts of implementing communications policies, namely their application to reality and the attempted enforcement of the purported rules, cannot be reduced to a model or paradigm. This applies just as much to the currently fashionable pro-competitive and market-oriented regulation as to the now unfashionable structural and behavioural regulation.

All policies are dependent on some form of implementation, usually embodying interpretation and application of laws and policies, making of detailed rules, and responding to changes. For a communications entrepreneur or an ordinary citizen, the implementation stage may be more important than a the broad decision about the future of communications. From a government viewpoint, the ultimate success of policies will depend on the quality of the means for implementing it.

II. The Range of Decisions: Who Has the Power?

Electronic communications is divided into three spheres in Australia, officially known as telecommunications, radiocommunications and broadcasting. 'Radiocommunications' refers to non-broadcast uses of the radio frequency spectrum for communications.(2) The services governed by the three separate regimes are converging, and the thrust of current policy developments is to aim towards a more universal or uniform scheme which deals similarly with all decisions about electronic communications.(3)

Before considering what access is available, and should be available, to the decision-making processes which determine the ultimate outcome of laws and policies, it is necessary to ask who makes the decisions. In Australia, much attention has been focused not on the elected government but on the separate statutory regulators such as the Australian Telecommunications Authority (AUSTEL) and the Australian Broadcasting Tribunal (ABT). Such opportunities as exist for business and consumer interests to make a contribution are available mainly through these two bodies.

A. Are Generalisations Possible?

An outline of powers over electronic communications which spoke only of the decision-making institutions, without mentioning the environment in which they live, would be misleading. The institutions are organs of a system of government. To illustrate the problem, many well-intentioned international discussions of accountability in broadcasting compare the hearing processes of different countries as if they were designed on an empty slate, specifically to suit the special nature of communications services. In fact, bodies such as the CRTC, FCC, and others are creatures of their own systems of government. To take the FCC as an example, its processes have more similarity to other US federal regulatory agencies than to communications regulators in other countries. To a large extent, the FCC procedures appear to be more the products of the US Administrative Procedure Act and other US administrative laws than of communications policies. Furthermore, US influence has led to much international copying of the idea of a separate statutory authority to govern communications. It should not be forgotten that the US constitutional structure, with an executive not answerable to a parliament and a non-elected cabinet, has led to a prevalence of statutory regulatory authorities. The model does not necessarily suit other systems of government.

B. The Unique Constitutional Environment

To explain the Australian decision-making processes it is necessary to make a few sweeping generalisations about government in Australia. The national constitution confers virtually all powers over electronic communications on the Federal government, known officially as 'the Commonwealth'. This makes the Australian approach to communications different from federations such as Germany, the US and Canada, where Lander, State or Provincial governments exercise some power. However, it does not mean that government is in practice so centralised as in unitary states such as New Zealand or the United Kingdom. A particular difference between Australia on the one hand, and New Zealand and the UK on the other, is that Australia has a Senate as well as a House of Representatives. The Senate has power to block or amend legislation. The details of these arrangements may not matter, but they do show that direct comparisons between the 'government' role in different nations are dangerous unless relevant constitutional environments are borne in mind.

The conventional view of Australian federal government is that the Parliament makes the laws. The elected government (for practical purposes, the Ministers), working on a basis similar to that of the British cabinet, makes policies within the framework of the laws. There are many references in this paper to 'the Minister' or 'the elected Ministry'. In practice, this means a person (currently the Minister for Transport and Communications) who is an elected member of the government party, acting on his own initiative, or the initiative of the federal Cabinet, or through the relevant department (currently the Department of Transport and Communications). The courts determine the meaning of the laws, and are responsible for their enforcement. Australian courts do not administer a general bill or charter of rights, so that they do not exercise the same supervening policy-oriented role as in North America or continental Europe.

Nobody suggests that the theoretical model actually works as intended. For example, a system of administrative law introduced in the mid-1970s(4) has drawn the courts closer to the merits of administration and policy-making than one might expect. More fundamentally, Australian communications has been subject to frequent and tumultuous legislative change in the last fifteen years. It can be argued that the Parliament has often been used as the tool for detailed administration. The broadcasting legislation is subject to several major amending Acts in most years. Although telecommunications laws were completely rewritten in 1989, they are to be subjected to major amendments in 1991. The Radiocommunications Act has changed little since it was rewritten from scratch in 1983, but it is expected to undergo a major change in 1991 or 1992.

A Northern hemisphere jurisprude following Hart or Kelsen would have the greatest difficulty identifying anything in the nature of sovereignty, a recognition principle, or a hierarchy of norms in Australian communications law. In practice, the government might change even the most basic communications laws if a court makes a decision with which it disagrees, if a powerful interest group wants the law changed, or if someone thinks there might be a better way to do things. This seems to be a great contrast with the US, where more changes come more from the courts and regulatory agencies. It is a contrast with the UK, where unwritten political balances and conventions make even some reforms of the Thatcher government seem slow and predictable by Australian standards. This difference affects access to decision-making. On many policy issues, access to Ministers, and to Senators who often hold the balance of legislative power, is more important than it would be elsewhere. In conclusion, the access which matters most is access to legislators, and there are no set pathways to it or restrictions on it.

C. The Limited Roles of the Separate Regulators

A reader of this paper may wish to stop and ask why there should be so much discussion of the role of the elected government in Australia, when the international and comparative literature, and much of the official Australian literature, deals mainly with the ABT and AUSTEL. Are they not the well-known local equivalents of the FCC or the CRTC, with the one difference that in Australia telecommunications and broadcasting are administered by separate bodies rather than by a single authority? The answer is, with some regret, that the two separate authorities do valuable and important work, but they are just prominent trees on the periphery of the government wood. The easiest way to explain this is to offer a short list of functions which the regulatory authorities do not perform, as well as some of the functions which the elected ministry does perform.

1. AUSTEL

a) Powers not Held

- Monitoring or regulating privately-owned telecommunications services.(5)
- Remedying consumer complaints about telecommunications services.(6)
- Requiring or distributing information about privately-owned telecommunications services.(7)
- Granting licences to provide telecommunications services.(8)
- Deciding whether carrier services are to be subject to price control.(9)
- Conferring rights to use radio frequencies.(10)

b) Relevant Ministerial Powers

- Power to give AUSTEL directions about nearly all aspects of its activities.(11)
- Appointment of all members of AUSTEL.(12)
- Appointment of board members of the carriers (Telecom, OTC and AUSSAT).(13)
- Power to dismiss board members of Telecom for 'unsatisfactory performance'.(14)
- Appointment of managing directors of the carriers.(15)
- All other 'shareholder' powers over the carriers.
- Budgetary control of AUSTEL(16) and Telecom.(17)
- Control of all uses of the radio frequency spectrum.(18)
- Setting of rules for local content in telecommunications equipment.(19)
- Power to require AUSTEL to investigate and report on any matter concerning telecommunications services or the telecommunications industry.(20)

2. ABT

a) Powers not Held

- Deciding whether to call for applications for broadcasting licences.(21)
- Planning new broadcasting services.(22)
- All technical aspects of broadcasting operations, including the right to use the frequency spectrum.(23)
- All aspects of Australian Broadcasting Commission (ABC) and Special Broadcasting Service (SBS) operations.(24)
- Most issues about concentration of control of the media (governed instead by the Act).(25)
- All aspects of pay TV and cable TV (only limited operations permitted by the government at present).(26)
- Most aspects of limited broadcasting licences (licences granted for certain 'broadcasting-like' purposes).(27)

b) Relevant Ministerial Powers

- All planning and technical aspects of the broadcasting system, including all aspects of spectrum and frequencies.
- Initiating new broadcasting services.
- Appointment of members of Broadcasting Tribunal.(28)
- Appointment of board members of the ABC and SBS.(29)
- Appointment of executive director of SBS.(30)
- Provision of technical facilities for transmitting ABC and SBS programmes.(31)
- Licensing and control of all radiocommunications services.(32)

D. The Role of the Minister and Elected Government

Having listed the powers of the separate regulatory authorities independently, it is not necessary to set out a list of powers held by the Minister. Such a list would be a long one, as the Minister for Communications directly controls virtually all the planning of electronic communications, as well as the finances of, and appointments to, the public enterprises and regulators. The Minister makes all the decisions, except for the small number which have been specifically entrusted to the separate regulators.

The practical significance, although not the conscious intention, of reposing so much authority in the hands of the Minister is to exclude most rights of access. Australian legislation, and the courts, are less inclined to recognise rights of access to the political and departmental level of government than to the separate authorities. For example, the Ombudsman's jurisdiction does not extend to decisions of Ministers(33), and the Freedom of Information Act does not apply to Cabinet or Executive Council documents.(34) There are few specific rights to make written submissions, to be heard orally, to know or challenge an opposing view, or even to know that somebody else has made an application for a right or privilege, in relation to powers of the Minister.(35) Generally, parliamentary and electoral accountability are sufficient access.

However, there are some other mechanisms which have a significant role in the Ministerial area, where the policy content of decisions is high. It is part of the role of both AUSTEL and the ABT to report to the Minister on issues within their respective areas at the request of the Minister(36). Each body has investigated significant policy issues and published reports for consideration by the government under these powers. The concept of such independent policy reports to government is hardly a novel one, but it is worth pointing out that it provides a useful tool for access to decision-making when the ultimate decision must be political. A separate authority can conduct an investigation more exhaustive than a Minister or Department could contemplate. It can ensure that all relevant interests are heard, and it can even create a degree of presumption in favour of its recommendations to government if the report is clear and cogent enough.

In the broadcasting area, obligations to consult also make a contribution. The Minister is required to consult organisations of broadcasters about planning matters which affect them.(37) More significantly, the legislation establishes the Broadcasting Council, which the Minister is to consult about 'matters generally affecting broadcasting in Australia'.(38) The Council considers matters raised by any of its members, who represent all sectors of broadcasting, or the Minister.(39) The Council considers most significant planning and policy issues, operating through informal meetings with the emphasis on consensus among members. Whilst a consultative body such as this can rarely resolve a deep-seated conflict of interest between broadcasters and government, or between sectors of broadcasting, it does produce consensus or a modus vivendi on a surprisingly large number of issues. This makes the government's planning role easier, and provides broadcasters with some opportunity to contribute to policy processes. The point to be made once again is that such a consultative council provides another tool for balancing the policy process with the opportunity for access to those affected. No similar consultative council operates in the telecommunications or radiocommunications area.

Before leaving the Minister's powers, it should be mentioned that where a Minister or Department is engaged in detailed administration as opposed to policy-making, it may be appropriate to devolve the work to a separate authority which will have the time and structure to allow more input from interested parties. It appears that Australian policy is moving towards this kind of process for administration of spectrum usage and broadcast planning, which at present lie with the Minister. The current Minister recently said that the government was 'examining the need for reform in the broadcasting planning processes. We intend to provide a more transparent process that also provides for proper commercial and public accountability.'(40)

III. The Right Place for Access to Decision-Making

A. The Policy-Individual Spectrum: from Macro to Micro

1. The Degree of Generality

Without descending into political theories, it is necessary to say something about the different kinds of decisions made about communications. Much tension and confusion have come from the failure to use the appropriate legal tools for the appropriate decisions.

Clearly, there are many decisions of an elected government which should be made on a political basis, with the electoral system the main avenue for accountability. At the other end of the spectrum are decisions relating only to specific, ascertained individuals and facts. In relation to these, the policy element is either absent, or of very low priority compared with effects on individuals. Examples of these individual decisions are the trial of a person accused of a crime, a decision about whether a person should be awarded a pension, and occupational licensing. The different kinds of decisions require different levels of factual investigation, access to information, and opportunity to challenge opposing views. To offer some extreme examples, it would be absurd to suggest that every welfare recipient should be individually consulted before the government frames its annual budget, or that a national Treasury should conduct public hearings before it acts to raise or lower interest rates.

Many communications decisions lie in the middle of the spectrum. For example, one may take a decision by AUSTEL to set the price for a service provided by a telecommunications carrier. To some extent, it is a decision directly affecting that carrier and its prospects of financial success, which can be related to known facts about the state of the telecommunications market. However, it also has significant policy elements. It sets the environment for all consumers of those services, and it may be related to broad policy objectives set by the government and legislation, about the appropriate role for competition and community service. The individual effects and fact-based elements lend themselves to investigation by detailed inquiry, but the policy elements do not.

2. Uncertainty and the Time Dimension

One important ingredient of specific, ascertained facts is that they usually exist in the present or the past. Thus, it is possible to conduct a detailed investigation of what actually happened in a motor accident, and to test the recollection of all witnesses before arriving at the closest approximation to the truth. Policy decisions are usually about how affairs should best be conducted in future. The policy challenge is how to allow for uncertainty, and the greatest pitfall is to place too much reliance on estimates and projections about what the future may hold.

This is an area where lawyers have often made a negative contribution. If economists have been seduced by the perfection of theories, lawyers have been seduced by the attempt to reduce policy to measurable, factual dimensions. This has been one of the main factors discrediting the opportunities for public process in Australian broadcasting. The creation of the Broadcasting Tribunal in 1977 opened the possibility for more public and industry access to decisions about broadcasting licences and programme standards. The years since have seen a gradual but inexorable narrowing of the issues in most kinds of inquiry. The lawyer's frequent contribution has been to apply the procedural and evidentiary skills developed for the different task which courts perform in deciding individual disputes to decisions about broadcasting which have a significant policy element. Thus, there is a reductionist tendency to isolate the contested issues, to enumerate the facts, and to test the validity of any proposition by cross-examination.

Lawyers have attempted to establish through oral testimony and cross-examination of witnesses a 'case' about issues such as: the likely degree and effects of concentration of media control; the needs of children; the depth of community concern about a particular kind of programme; the comparative suitability of rival boards of directors to manage a proposed new radio station; and the likely future growth of a television market. At best, these reductionist processes have allowed the views of expert witnesses to be tested. At worst, they have discredited the concept of rights to contribute to decision-making. The solution is not to abolish detailed inquiries. Rather it is to direct detailed inquiries and the lawyers' court-like processes towards the fact-oriented areas where they can be productive.

B. Freedom of Speech

Most of what has been said so far would relate to any area of mixed factual investigation and policy. However, there is a special consideration governing communications, namely freedom of speech.

It has been accepted as a principle in Australia, as in many countries, that the elected government should not have any direct role in regulation of the program content of radio or television and more than it should in newspapers. The prevailing rule has been 'hands off', and it has been accepted for many years. The 1976 Green Report, which was the blueprint for the broadcast licensing system which now operates, made it plain that there was a need to separate the licensing of broadcasting from the ordinary business of government.(41) There was consensus from commercial and non-commercial interests and from all sides of politics that the opportunities for political interference in broadcasting should be minimised. No such principle has been recognised in telecommunications or on the planning side of broadcasting. Indeed, the rate of technological change seems to have led all relevant interests to demand that the government take a firmer grip of planning and policy about the new technologies. Thus, we have a serious clash of principles coming from the broadcasting and telecommunications ends of the spectrum. When does commendable government activism become political intervention in the citizen's avenues for freedom of communication?

The statute which occupies most of the contested area is the *Radiocommunications Act*, which gives the government a relatively unfettered discretion to grant licences for use of the radio spectrum to whom it wishes, and in what manner it wishes. There are many uncontroversial categories of licences for point-to-point communications, but there are also many point-to-multipoint and even broadcast licences which give rise to great controversy. The most prominent category is VAEIS (Video and Audio Entertainment and Information Services), but there are other applications such as ACS (Ancillary Communications Services) and MDS (Multipoint Distribution Services). So far, the question which has received most public attention is the 'good housekeeping' issue of what is the appropriate legislative regime for these services. But lying behind that question of form is one of substance, namely how open and accessible is the system for getting access to frequencies, and how much objective review is there of the process. For example, there has been little scope for competition in gaining radiocommunications licences, even where the licences have been very valuable. Many licences are granted on a first-come first-served basis, without others having the opportunity to know that a new category of licence may be regarded favourably. There are few stated reasons for decisions to grant radiocommunications licences, nor opportunities to know whether and why one use of the spectrum has been preferred to another. This is another area where reforms are likely within the next year.

Is there any obvious solution to the freedom of speech issue? Great reliance is placed on the content-carriage distinction, with content being seen as the main area where the government need exercise restraint. Unfortunately, this distinction is more effective in theory than in practice. For example, if the government can decide whether a certain kind of broadcasting or radiocommunications service should be provided to a certain area, and on what conditions, can it be said that the government is avoiding content regulation? An ethnic, religious or political group which has been unable to obtain access to any suitable kind of licence would probably say that the planning processes do reach into content regulation. Others would argue that the planning process is only a form of resource allocation, and that such problems as exist now can be resolved through procedures such as auctioning rights to use frequencies,(42) which allow the marketplace to determine detailed planning in place of a direct governmental role.

IV. The Existing Rights of Access

The usual, and most practical, forms of access to decision-making are through opportunities to provide information to the decisionmaker, to challenge information provided by others, and to participate in discussions about what would be the best decision. There are different degrees of these rights, ranging from the right to submit a written submission, up to the fuller rights of participation, such as full access to all material which will be considered before a decision is made, and the right to orally present information and ideas as well as challenging similar material from all others interested. An example of the first is the right to write a letter to a Minister. An example of the second is provided by the full rights of natural justice (due process in North American terms) accorded by the courts in criminal trials.

A. AUSTEL

The telecommunications laws do not provide for oral hearings before decisions are made by AUSTEL. The main form by which hearings are excluded is a series of express references to written representations in the *Telecommunications Act 1989*, the effect of which in most cases is to exclude anything more than written submissions.(43) The reasons usually cited by the government for this exclusion have been the expense and delay which oral hearings cause. AUSTEL is not prohibited from conducting hearings; and in practice it has made strenuous efforts to provide informal contact with those who approach it for information or to express a view. The key differences between AUSTEL's situation and that which obtains before many other Australian tribunals, federal and State, are:

- Where a hearing is provided, it will be provided at the discretion of AUSTEL;
- AUSTEL does not have the power to compel people to attend hearings or conferences, to produce documents, or to answer questions. It does have some powers to obtain information from the carriers, particularly Telecom, which might conceivably be used in relation to a hearing or conference.
- Those taking part in an AUSTEL hearing or conferences do not have the legal immunity from liability for defamation, contempt and the like which has been considered necessary for some other tribunals.
- Relatively full rights to a hearing are available to many parties who appeal against AUSTEL decisions to the Administrative Appeals Tribunal (AAT).(44) The pros and cons of this kind of full appeal, and its effects on the original decision-making process, would require a separate paper.

B. The Broadcasting Tribunal

Going to the other end of the range of access rights, the ABT certainly has the power to conduct a hearing before most important decisions. For legal reasons and because of widespread expectations, there would be insuperable obstacles to dispensing with a hearing before the making of a significant decision. The combined effect of the *Broadcasting Act 1942*, the *Australian Broadcasting Tribunal (Inquiries) Regulations 1986* and a number of cases interpreting the legislation is that most persons affected by ABT decisions, in the narrow range within which the Tribunal operates, have relatively full procedural rights loosely corresponding to those prevailing in a court. If a party wishes to require an oral hearing, and to cross-examine opposing witnesses, the Tribunal is unlikely to be able to resist that claim. However, recent years have seen an increasing tendency for the proceedings of the Tribunal to resemble a species of civil litigation. The ABT has been quoted as an example of expense, delay and complexities which are not wanted in any other sector of communications. There are some considerations which must be set against this view. Most of the time consumed by oral inquiries has been occupied in cross-examination of witnesses. The cross-examination has been of doubtful value. If parties were entitled to say why others were wrong, but not entitled to cross-examine almost indefinitely, hearings would take a fraction of the time they sometimes do. Efforts of Tribunal members to eliminate irrelevant material and prolix procedures have been limited by the Act and Inquiries Regulations. Unlike most tribunals, the ABT has very little power to set its own procedures.

C. Written vs Oral Access

As indicated above, access is through writing in some cases and through some form of oral hearing in others. The question of when written contributions to the process are appropriate, and when it is necessary for the decisionmaker to be personally present to hear an oral presentation, may seem like a matter of detail, not worthy of such prominence. But modern technical progress has found no substitute for the physical presence of a decisionmaker as the only way to ensure that views and information are really communicated to him or her. Even the most strongly entrenched right to make written submissions to a decisionmaker cannot ensure that the decisionmaker will perform his or her duty to read what is submitted. S/he may put the most carefully-researched material on the shelf, or in the waste paper basket. If s/he is concerned to maintain the appearance of taking an interest, s/he may delegate the task of reading to a subordinate, who may also be delegated the task of drafting a response which conveys the semblance of careful study. Where it is important to ensure that information or opinion is communicated to the decisionmaker, there is no substitute for the personal presence.

This does not mean that the people who make decisions about communications should spend all their time in a personal dialogue with those who wish to express a view. It does mean that the opportunity for oral communication of some kind does need to be inserted at critical stages of all the decision-making processes. A proper allocation of this time, and a proper division between material which belongs in the written medium and material which does not, can improve the quality of decisions made. It can also ration the time of decisionmakers more effectively. For example, the Broadcasting Tribunal could be liberated from some aspects of its adversarial hearings. AUSTEL could be liberated from some of the individual inputs it now receives if the legislation gave it more opportunity to hold conferences with all interested parties in the presence of each other.

V. Conclusions

The inconsistencies and problems revealed in the Australian experience point to some productive means for reforms which would lead to greater efficiency in decision-making.

The most important reform would be to recognise the extent to which policy-makers and their decisions can neither predict or dictate the future. In other words, it is necessary to recognise that the new decisions now being made in the course of communications reform will face the same long, hard road of implementation and interpretation as decisions taken long ago. The processes and procedures of implementation will determine the final outcome. Once this is recognised, it is easier to accept that the processes need much closer attention that they have received to date.

The next step reform is to apply the right procedure to the right kind of decision. As illustrated above, there has been a tendency to take an all-or-nothing approach to rights of access in Australian communications. This is the problem of Rolls-Royce justice: travellers are offered no alternative between a very expensive motor car and travelling on foot. The Rolls Royce has been the Broadcasting Tribunal, many of whose inquiries have the same procedural protections for parties as a criminal trial. The alternative has been most of the powers exercised by the Minister and Department of Communications, where there are virtually no rights of access. The access granted, quite considerable in many cases, depends on the goodwill of the decisionmaker.

It is still possible to incorporate access to decision-making which has a high policy content. The Broadcasting Council and the other rights to be consulted by the Minister illustrate this. In many situations, an obligation to consult is more productive than the adversarial processes of the court-based model. It provides the opportunity to for marshalling information and ideas in a positive direction. However, rights to consultation are not the magic answer any more than any other tool for access.

The important point is that there is a wide range of tools, and the right one should be used for each occasion. If all tools are rejected on the ground that one has been tried, and found too cumbersome or too expensive, the products of the decision-making system will be less well-made.

Notes

1 The author is grateful to his colleague Mr David Lindsay of CIRCIT for extremely valuable research assistance in preparation of this paper. The views expressed in the paper are the authors's own personal views, not referable to CIRCIT or to the Broadcasting Council, of which he is chairman.

2 Section 3 of the *Radiocommunications Act 1983* defines 'radiocommunication' to mean: '(a) radio transmission; or (b) reception of radio transmission, for the purpose of communication of information between persons and persons, persons and things or things and things.' The *Broadcasting Act 1942* effectively defines 'broadcasting' to mean radiocommunications services transmitting radio or television programs to the general public': Broad-

casting Review Group, Department of Transport and Communications, *Review of Broadcasting Regulation: Discussion Paper,* AGPS, Canberra, 1989, p 3.

3 For example, the 'modular approach' envisaged by Broadcasting Review Group of the Department of Transport and Communications: Broadcasting Review Group, Department of Transport and Communications, *Review of Broadcasting Regulation: Discussion Paper,* AGPS, Canberra, 1989, p 3.

4 D Pearce (ed) *The Australian Administrative Law Service,* Looseleaf, Butterworths, Sydney, 1979-, Vol 1, paras [119], [121]-[147]; J Goldring and I Thynne, 'Administrative Review, Public Morality and the Integration of Administrative and Legal Cultures' in A Kouzmin and N Scott (eds) *Dynamics in Australian Public Management: Selected Essays,* MacMillan, Melbourne, 1990, pp 146-160; M Aronson & N Franklin, *Review of Administrative Action,* Law Book Company, sydney, 1987, pp 241-266; *Administrative Appeals (Judicial Review) Act 1977.*

5 Under the *Telecommunications Act 1989* (Telecoms Act) AUSTEL's role in regulating competitive services consists of: protecting the reserved services of the carriers (s 69); issuing class licences for value-added services and private network services (s 75); and making declarations that services are unlicensed (s 91). AUSTEL has an extremely limited role in relation to services which fall within the broad parameters of the class licences.

6 While AUSTEL is given the power to investigate some consumer complaints under s 148 of the Telecoms Act, its powers of enforcement are limited to making references to the Ombudsman (s 152) and the Trade Practices Commission (s 153), and preparing reports to the Minister (s 155).

7 AUSTEL has the power to obtain information and documents from the carriers: s 180 Telecoms Act. One of its functions is to give advice and assistance to the Australian telecommunications industry: s 18(b). It has no other powers to require or compile information, and no duties to supply information to the public.

8 Under Part 4 of the Telecoms Act AUSTEL is empowered to grant class licences for value-added services and private network services. The class licence system differs from the usual licensing regime in that it governs all participants in the relevant markets and there are no applications for individual licences. It is arguable, therefore, that class licences are more in the nature of delegated legislation than conventional licences.

9 It is the responsibility of the Minister under s 62 of the Telecoms Act to determine whether a reserved service is subject to price control arrangements. Under s 63 the Minister is also responsible for determining the kinds of price control arrangements to be applied.

10 This is the role of the Minister under the *Radiocommunications Act 1983.*

11 Telecoms Act, ss 27-29. Under s 73 the Minister is empowered to give AUSTEL directions about the way in which it is to perform its class licensing functions, and in relation to the circumstances under which persons are to be taken to have a common interest for the purpose of providing private network services. Under s 111 the Minister is empowered to give AUSTEL directions about the way in which it is to perform its functions relating to the issue of equipment permits and cabling licences.

12 Telecoms Act, s 158.

13 *Australian Telecommunications Corporation Act 1989* (ATC Act), s 69; the Commonwealth acquires the power to appoint the board of OTC Ltd from its position as sole shareholder; Article 60 of AUSSAT's articles of association provides for the directors of AUSSAT to be appointed by the Commonwealth or Telecom (with restrictions on the number of directors who can be appointed by Telecom).

14 ATC Act, s 75.

15 ATC Act, s 69; Article 74 of OTC's articles of association; and Article 83 of AUSSAT's articles of association.

16 AUSTEL is funded from the budget.

17 Section 36 of the ATC Act empowers the Minister, upon receipt of Telecom's corporate plan, to give directions to the Board to vary: (a) the statement of strategies and policies that Telecom is to follow to carry out its community service obligations; and/or (b) the financial target under the plan.

18 Under the Radiocoms Act.

19 The Industry Development Arrangements (IDAs) for customer premises equipment operate as a general policy of the Commonwealth Government notified under s 28 of the Telecoms Act.

20 Telecoms Act, s 148(3). Under s 50 the Minister may require AUSTEL to investigate and report on whether a particular kind of network or facility should be provided by a carrier, rather than made available for its use by another carrier.

21 Reserved to the Minister under s 82 of the *Broadcasting Act 1942*; M Armstrong (ed) *Communications Law and Policy in Australia,* Butterworths, Sydney, 1987-, looseleaf, para [4010].

22 Section 125D of the Broadcasting Act makes the Minister responsible for planning the development of broadcasting, determining standards of technical equipment, correcting interference and examining and certifying technical operators.

23 M Armstrong (ed) *Communications Law and Policy in Australia,* paras [4000]-[4055].

24 The ABC and SBS are not subject to ABT program standards, although the ABC is required to take account of the standards by s 6(2)(a)(ii) of the *Australian Broadcasting Corporation Act 1983.*

25 Limitations on ownership and control are set by Part IIIBA of the Broadcasting Act. The Tribunal's power to scrutinize a takeover bid prior to the acquisition of shares was removed by the *Broadcasting and Television Amendment Act 1981.*

26 Video audio entertainment and information services (VAEIS) are restricted to services transmitted to receivers in 'non-domestic' premises. They are licensed under the Radiocoms Act.

27 Although the Tribunal is empowered to grant a limited licence, under s 82AB of the Broadcasting Act the Minister may call for applications for limited licences, dismiss an application, or defer consideration of an application.

28 Broadcasting Act, s 8.

29 ABC Act, s 12; Broadcasting Act, s 79H.

30 Broadcasting Act, s 79Q. The managing director of the ABC is appointed by the board: ABC Act, s 13.

31 ABC Act, s 74; Broadcasting Act, s 73.

32 Radiocoms Act.

33 Although it may extend to delegates of the Minister: *Ombudsman Act 1976* s. 5.

34 *Freedom of Information Act 1982*, ss. 34, 35.

35 Some specific exceptions are: the right to make representations to the Minister about changes in technical conditions of broadcasting licences, mentioned above; and the right to appeal to the Administrative Appeals Tribunal against Radiocommunications licensing decisions, mentioned below.

36 Telecoms Act, s. 148(3); Broadcasting Act, s. 18(2).

37 Broadcasting Act, s. 125D(2)(a).

38 Broadcasting Act, s. 125D(2)(b), *Broadcasting Council Regulations 1981.*

39 *Broadcasting Council Regulations 1981*, reg 5.

40 Hon. Kim C Beazley, Minister for Transport & Communications, Second Reading Speech on the Broadcasting Amendment Bill 1990.

41 Postal and Telecommunications Department *Australian Broadcasting* (Canberra, 1976) pp. 4-5, 69-70, 72.

42 Bureau of Transport & Communications Economics *Management of the Radio Frequency Spectrum: an Economic Analysis* BTCE Occasional Paper 102, Canberra, AGPS, 1990 points towards a system of auctioned, tradeable spectrum access rights.

43 E.g. Telecoms Act ss. 78(2), 79(2). It may be that parties such as cabling contractors whose licences are in jeopardy could be entitled to more than written representations: s. 137.

44 Telecoms Act, s. 178; I Cunliffe, 'AUSTEL: Functions and Powers' in M Armstrong *Telecommunications Law: Australian Perspectives* Media Arm, Melbourne, 1990, pp. 256-58.

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Global Networks - PTT Opportunity A Banking Example

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1. ABSTRACT

The drive toward a more competitive global telecommunication environment demands a more market oriented approach by service providers. A focus on what can be done now to satisfy the needs of heavy telecommunications users such as the banking/financial services industry can result in improved competitive advantage in this environment. Service providers must increasingly position themselves away from commodity services and move toward high margin application oriented solutions. The network tools are now in place to begin making this transition.

2. THE GLOBALIZATION OF INDUSTRY AND TELECOMMUNICATIONS

In response to intensifying competitive pressures in the global business environment, industry is undergoing a transformation from a rigid hierarchical orientation to a horizontal structure that crosses national boundaries. Increasingly, decisions are being made from a global framework. These decisions can can range from a financial transaction to be executed on any one of the bourses in the world, to an operational strategy that allows factories in Europe to handle overflow from North America or the Far East.

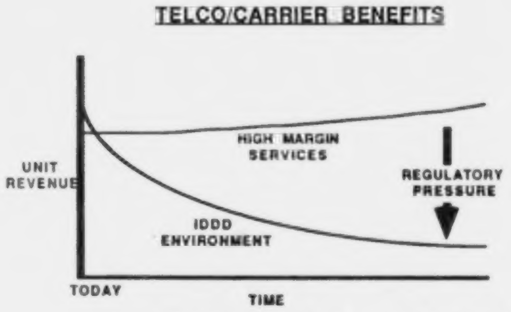
Effective intra- and intercompany communications are becoming ever more important both in the day-to-day operations and in the strategic directions of multi-national business. The value of the global business' communications network in competing in the world's shrinking marketplace is undeniable: yesterday a global communications network offered the multi-national business competitive *advantage*; today that network is required as a matter of competitive *necessity*.

Notwithstanding the cost sensitivities and reliability demanded of the network, multi-national companies look to the network to help streamline the distribution of internal information, while enhancing the information exchange process with trading partners and customers.

Many of the communications requirements are extensions of what these corporations already do domestically or regionally. In some cases applications assume a much greater significance in a global environment than in a domestic environment. For example, facsimile and electronic mail are used much more heavily between locations which have little or no overlap in their business day, due to large time zone differences (e.g.eight to twelve hours). The very high cost of intercontinental travel, both in terms of air fares and the extensive time required, make the use of such applications as Dial-up Video Conferencing even more attractive in a global environment.

In other cases, businesses can do new things. For example, Global 800 service coupled with Networked Automatic Call Distribution (NACD), can allow a corporation to take advantage of lower labor rates in some parts of the world, establishing operator groups in those regions. These and other applications are discussed in some depth below.

Until recently, private networks were the only way to implement many of the services currently enjoyed domestically by large multinational corporations. However, now PTTs, along with alternative service providers (ASP's), are uniquely positioned to assist end-users faced with high tariffs, network design and implementation issues and operational difficulties. Armed with rich experience in these areas, PTT/ASP's can address these business problems with customized solutions, combining international direct dialing, leased lines facilities, and increasingly, global hybrid and virtual private network solutions.



- NEW BUSINESS SERVICES REVENUE OPPORTUNITY
- LEVERAGES PUBLIC NETWORK
- ACCOUNT CONTROL

High Margin Revenue Potential

FIGURE 1

In today's environment of relaxed PTT/ASP regulations, PTT/ASP's are at a crossroad; to avoid being caught in the trap of providing commodity transport, they must develop applications which add value to the end-user's operation. The PTT/ASP must leverage network assets and market presence while offering network-based services. By doing so, their value-added differentiated networks will have high margin revenue potential, as they provide cost effective solutions to end users. (Figure 1).

Global telecommunication requirements of large multinational companies present a particularly unique opportunity to offer high margin services that are needed now. In the remainder of this paper, we will discuss the global networking requirements of the financial industry and their implications for PTT/ASPs. These requirements are often a forerunner of requirements for other industries which administrations will be able to serve in the future.

3. GLOBAL TELECOMMUNICATION REQUIREMENTS OF BANKS/FINANCIAL INSTITUTIONS

3.1 Banking - A Leading Illustration of Telecommunication Requirements

Leading multinational banking/financial institutions are among the heaviest users of global telecommunication services. According to noted futurist, Dr. Harris Sussman, "Banking is telecommunications." The banking industry as we know it today would not exist without a modern telecommunication network in place. For the banking industry to expand its capabilities, the capabilities of the telecommunications services and systems upon which it relies must also expand.

3.2 Financial Hub and Spoke Networks

Financial networks operate on a hub and spoke concept. The hubs are the key world financial centers, and the spokes are the regional networks which feed into them. Typically, the regional networks operate in similar time zones, while the major hubs are in significantly different zones. Key world hubbing locations for financial networks are New York , London, Frankfurt, Benelux , Zürich, Hong Kong, and Japan. Some secondary hubs are Bahrain, Bombay, Australia, and Singapore. The importance of Singapore and Australia are expected to increase.

This network configuration offers several opportunities for PTT/ASP's to provide service. First is the provision of major switching centers for network intelligence at network hubs. Second is the provision of interconnectivity between nodes. This is a vital function both for hub to hub and hub to spoke communication. Third, is the provision of high margin application oriented services to users of these networks. PTT/ASP's can implement these services within key financial hubs around the world and enhance their own competitive positioning.

4. THE OBJECTIVES OF BANK MANAGERS AND THE NETWORK

4.1 Banking Objectives

From a line of business manager's perspective, key objectives include improving client relationships, exploiting transaction services, facilitating information distribution and reducing backroom costs. Backroom costs can be defined as costs associated with the documentation and processing of the huge volume of transactions that pass through a bank. Above all else, client relationships, customer service and sales effectiveness translate directly into product differentiation and revenue enhancement. In this highly competitive business, new lower cost ways of delivering new services are key elements of success. Equally important is the requirement, as in all businesses today, to deliver new services and products more rapidly, to differentiate the business from competitors as well as for survival.

4.2 Improving Client Relationships

Two principal aspects of improving client relations are better responsiveness to the customer and connecting the customer with the right people as quickly as possible. Some examples of network services which meet these objectives include: concurrent display of customer records with incoming calls, automatic call distribution, dial-up video for high profile personal relationship banking and publicizing offerings, and global 800 services.

Concurrent display of customer records with incoming calls can be effective in many banking applications. Customer service and sales/sales support are two key areas. In customer service applications, account inquiries can be responded to quickly. If further specialized assistance is required, the screen of information can be transferred to the next expert, thus avoiding costly and time consuming repetition of basic information. This allows the bank employee to concentrate on the reason the customer/prospect called.

Sales leads can also be generated as part of the customer service application. To do this the customer service representative typically asks about customer interest in other bank products, such as retirement planning, loans, credit cards, etc. If interested, the caller and the complete screen of information are transferred to the sales expert for that project.

Sales/sales support can also stand on its own, responding to requests for information, evaluating loans, signing up new accounts etc. The same kinds of advantages apply in sales/sales support as in the customer service application.

All these services can be offered globally, with computer databases of customer records or sales information accessed automatically from offshore data centers. The expense of operating a major data center can thus be shared among multiple global locations. These services are available now through established alliances of computer and switching vendors.

The services described can have a major positive impact on customer relationships and improve productivity. They can be achieved when Calling Line IDentification (CLID) or Automatic Number Identification (ANI) travels with the call. The CLID is used to access customer records and deliver those records simultaneously to a co-located data terminal as the voice call is answered. Even when the CLID does not travel through the network, voice response units (VRU) can automatically request the caller to provide the account information which will enable his records to be retrieved from the bank's data base(s). In countries where the DTMF signaling necessary for voice response units is not yet widely available, a specific group of operators can screen calls and manually input CLID, or account numbers, and route the call to appropriate specialist operators. All of this is illustrated in Figure 2.

These customer service and sales/sales support applications will often generate very large volumes of traffic. In order to handle these call volumes promptly and effectively, Automated Call Distribution (ACD) and the more advanced Networked Automated Call Distribution (NACD) can be placed at the front end of a specific application. (Figure 3). These services queue and manage inquiries. As a result customers gain better service, and fewer calls are lost due to premature hang-ups. Until now, ACD functionality was only available on PABXs on a private network. Network based ACD is made possible with the use of CCITT No. 7 signalling.

NACD has many advantages compared to ACD. First is dynamic real-time load balancing with resulting improved efficiencies. NACD allows a corporation to operate multiple ACD groups as if they were a single resource. Equally important for a global corporation is the ability to offer 24 hour service to customers from operator centers that may even be located on another continent. Alternatively, calls may be routed to an operator group with appropriate language skills for the calling party. Or companies may choose to take advantage of lower labor rates in certain parts of the world, routing as many calls as possible to those regions.

Other network services that enhance client relations include Dial-up Video for high profile personal relationship banking and and Global 800 (Freedial) services for customer service and telemarketing. Although all these services are being used in innovative ways to provide new services, there is wide room for growth in the global marketplace for greatly expanded use.

Figure 4 shows some of the potential advantages of a Dial-up Video service in account building and maintenance of major accounts. Many other applications exist and are being exploited. Several banks using video consider it so important and strategic, that they are reluctant to reveal usage. Despite its growing popularity, many of these global users are not only forced into the inconvenience of making arrangements a week in advance to reserve scarce satellite channels, but have been paying premium rates for bandwidth of 768 kbps.

Use of Dial-up video on the other hand, allows meetings to be arranged on a "spur of the moment" or short notice basis. Of course, it can be used for regular meetings as well. Typically, bandwidth is allocated in units of 56 or 64 kbps. Current technology also allows two of these channels to be combined to give the user 112 or 128 kbps. Future developments will allow this bandwidth to increase in units of 56 or 64 kbps, although continued improvements in video codec quality may render this unnecessary. Users find that the quality now offered by the 112 or 128 kbps technology is sufficient for a majority of meetings held.

The ability to see people, especially clients who are distant from the banks central location, adds a much greater personal element. Experts who might otherwise not attend, can be brought into meetings and address issues quickly. Senior management, whose time is very a scarce and hence valuable, can also be much more easily brought into key meetings to add credibility and make decisions. Videoconferencing can also substantially reduce misunderstandings that can occur with audio-only teleconferences. It allows the exchange of visual information such as charts and graphs during the flow of a meeting, without the need for transmitting such information in advance by facsimile. This spontaneity adds greatly to the value of the meeting.

Advances in video communications technology, such as 64 and 128 kb/s full motion video, coupled with decreasing tariffs in intercontinental digital communications and decreasing video codec prices are making the dial up video conference both feasible and cost effective.

4.3 Exploiting Transaction Services

The objectives of exploiting transaction services may be divided into two groups: objectives for wholesale banking and objectives for retail banking. On the retail side of banking, the objectives of exploiting transaction services include improving response time to customers, increasing market presence and penetration for the bank, and offering a wider variety of new, innovative services. On the wholesale side of banking objectives include improving response time and reducing error rates (especially eliminating resending volumes of data). The result, for both wholesale and retail banking is reduced costs and increased revenues.

Transaction services are being exploited globally in all aspects of banking . Packet switched networks, with links into corporate and industrywide databases are currently being used for validation of Automatic Teller Machines (ATM) and Electronic Funds Transfer (EFTS) transactions. Continued growth is expected, with innovations in speed and reliability, resulting in increased market penetration and reduced cost. On the retail side, charge and credit cards, and debit /point of sale (POS) cards, are primary applications. On the wholesale side, a wide array of clearing services, market making services, and information services have emerged. These are growing rapidly in complexity as the need for more closely linked global financial networks grows. For example, the banking and financial service industries, are increasingly positioning themselves as global providers of funds and exchange services. The evolution to global 24 hour securities trading is another example of this trend.

Reliability and accuracy are essential requirements for these transaction services. High percentage uptime and error correction are necessities. Because the nature of this traffic is short and bursty, these requirements are typically met today through X.25 packet switched data networks using the X.25 protocol. X.25-based packet switching provides very high reliability. For faster throughput and response time, frame relay technology is starting to be implemented.

With frame relay, error correction need only be performed in the application layer protocol. Many current application packages are used in combination with X.25-based packet switching. In these applications, error checking frequently occurs twice - once in the data transport layer, and once in the application layer. This is because most applications now include error checking. TCP/IP, for example, is widely available and includes error checking. With X.25-based packet switching, error checking also takes place in the data transport layer. This adds considerable overhead to the time to process a message. Frame relay will solve this problem while continuing to provide high reliability.

4.4 Facilitating Information Distribution and Collection to Reduce Backroom Costs

In addition to reducing backroom costs, facilitating information distribution and collection aids in reaching decisions more quickly than competitors and disseminates critical information in a more timely fashion. The result is a strategic advantage for the bank over its competition.

Information distribution and collection are vital functions within a bank. The old adage "time is money" precisely describes this critical dimension in the international financial environment. This information flow includes voice, data, and image. A revolution is taking place in basic voice communication based on an increased urgency in reaching people. This revolution includes the use of voice messaging, voice response, faster call setup, uniform dialing plans, and personal locater services. And video conferencing is becoming vitally important for internal bank applications. These services, widely available in some national environments, are already migrating to the global environment.

A major advantage of the PTT/ASP is its expertise in global telecommunications technology. Implementation of the most current and most powerful telecommunications technologies, and optimization of the use of these technologies can substantially reduce the technology risk to the multinational corporation. This is particularly critical in applying such advanced technologies as ISDN and CCITT Number 7 Signaling to global telecommunications requirements of large multinational corporations.

6. IMPLEMENTING GLOBAL CORPORATE TELECOMMUNICATION NETWORKS

6.1 Approaches to Global Corporate Networks

Many different approaches are being taken to implementation of global networks today. In addition to existing private leased line international networks, new international services are appearing such as the U.S. Sprint/Cable & Wireless Global FON^{SM} and MCI's FeatureNet™. Global Centrex is becoming available. And other new approaches will emerge.

Interest in virtual networks and hybrid networks is very high among large, multi-location corporations today, with a growth rate in the U.S., for example estimated at approximately 60% annually. (5) It is now possible to extend this concept to international virtual networks. This represents an important new service opportunity for PTT/ASPs.

International virtual and hybrid networks can complement, and even substitute for leased lines and International Direct Distance Dial (IDDD) services. Depending on tariffs, they can be a cost effective way for the end user to trim operating costs without sacrificing the high reliability, availability, and level of service users are accustomed to with leased lines.

At existing tariffs, virtual circuits are more cost effective than leased lines over a wide range of traffic levels. Figure 5 compares IDDD, leased lines and virtual circuits for traffic between the United States and the United Kingdom IDDD is best for less than approximately 1200 minutes per month. From approximately 1200 minutes to approximately 12,000 minutes per month, virtual circuits are the most economical.

Many of the applications and features discussed earlier in this paper can be made available through virtual and hybrid networks. For example, disaster recovery, can easily be integrated into virtual networks by providing multiple alternate transmission/switching paths to existing leased line and IDDD networks as shown in Figure 6 Dial-up backup for sensitive data can also be made available. Using CCITT No. 7 signaling, dynamic rerouting of traffic around non-operating switching nodes and transmission paths can take place. All of these will increase reliability levels available in international corporate networks.

6.2 A practical concept for Global Network Implementation

Many of the services discussed in this paper rely on the rapid implementation of international standards, such as CCITT No. 7, both on a domestic and international basis. National variations in CCITT No. 7 make implementation of the concepts discussed above more complex than they would be if there were one worldwide standard. This situation is not likely to change in the near future. Because of this, provision of the ability to translate among the national variants of CCITT No. 7 signaling in the international gateway switches and/or in tandem switches immediately behind the international gateway is essential to implementing global networking.

Figure 7 shows one concept for a public/hybrid approach to providing the kind of service required by large multinational corporations. The top level of the network is comprised of international gateway switches operated by a mixture of national administrations and new international carriers. Features such as Common Dialing Plans, 56/64 kb/s switched data, Call by Call service selection, and a variety of business features can be provided from the gateway. Typical business features which can be provided for international calling include CLID, Network Ring Again and Call Forward. CLID can be extended to Calling Name display using data bases associated with the international gateway.

Interworking between various national implementations of CCITT No. 7 is the key to delivering these services to the national network. Depending on the regulatory structure of a particular country, it is also possible to deliver these services to customers connected directly to the international gateway (gateway based Global Centrex) and to PABXs connected directly to the gateway. In any case, the national version of CCITT No. 7 is used to deliver services from the gateway to the national network.

From the national network to the local switch or customer premises, ISDN Primary Rate Interface (PRI) is used to deliver the services. The end user can choose to receive the services either from a central office (Centrex) or PBX. Packet data can also be integrated into this scenario, using Packet Handlers and the X.31 protocol for X.25/ISDN interworking. The use of standardized, international PBXs or Centrex offerings conforming to ISDN requirements will guarantee the largest set of deliverable features. These requirements are increasingly easy to satisfy in the telecommunications environment of financial hubs.

7. SUMMARY AND CONCLUSION

Multinational corporations are highly dependent on telecommunication services. The banking sector is a leading sector in this regard. A focus on serving the needs of this sector can help PTT/ASP's understand and serve the emerging requirements of other major industry segments.

This paper has highlighted some of the high margin services that PTT/ASP's can provide to banks. Those providers that do so first will gain competitive advantage and increased market share. The telecommunications architecture and signaling requirements necessary are rapidly becoming readily available. Commercial programs focusing on vertical markets such as banking are a key element of success in the increasingly competitive global telecommunications marketplace.

8. REFERENCES

(1) "Global Networking" study and presentation by Nolan Norton Inc., a subsidiary of Peat Marwick and Mitchell

(2) "Strategies in Telecommunications Scenario", Eighth Annual Gartner Group Information Industry Scenario Conference, Gartner Group, 1989, p. 19.

(3) "Managers Fill Out Wish List of Global Network Services," *Network World*, Feb 5, 1990, p.48

(4) Northern Telecom internal analysis

(5) Virtual Networks: The Hybrid Solution, The Yankee Group, 1989. p. 6.

Global FON is a service mark of US Sprint Communications Company Limited Partnership

FeatureNet is a trade mark of MCI Communications Corporation

The use of these enhanced voice services provide the benefit of reaching another party more quickly, allowing critical information to be exchanged, and shortening the time required for decision making and transaction execution. Voice messaging and voice response are in a rapid growth stage in the U.S. market and acceptance is growing throughout the world.

Fast call setup (1-2 seconds) and a uniform dialing plans are fundamental network improvements which generate a more cost effective use of network resources, and are less time consuming for end users. Fast call setup, previously possible only with private leased lines is now possible as a switched service on the public network with the use of CCITT No. 7 signaling. A uniform dialing plan is widely used today in most private corporate networks and is accepted as a basic requirement. It is a service which is just now entering the market in global virtual networks. In the banking/financial industry, particularly, seconds saved translate into significant money savings. For example, seconds can make a large difference to the foreign exchange trader. Multinational corporations in this business are willing to pay premium revenues for fast call setup and uniform dialing plans on a global basis.

Personal locator services have been shown to generate great interest among global companies (1). Personal locater services will eventually evolve to include mobile services with assigned personal numbers reaching individuals wherever they may be. Even before this vision becomes a reality, PTT/ASP's will offer global call forward, global call transfer, Calling Line Identification (CLID), and Calling Name Identification. Calling Name Identification is an extension of CLID. When the CLID is received, a data base of names is interrogated, and the name associated with the CLID is displayed in addition to or instead of the calling number. Experience with this feature in corporate networks has been very positive.

The data services portion of information collection, distribution is viewed by most banks as even more critical than voice. Data traffic is also growing more rapidly than voice traffic. In the U.S., for example data traffic and enhanced services are projected to grow at an annual rate four to five times that of basic voice (2). Major applications include electronic mail, and transaction/file transfer and validation. For example, the telecom managers of Fortune 500 firms (U.S) currently cite electronic mail as their most frequently implemented international networked application (3). It is believed that this statistic can also be accurately applied to global banks. At least one major global bank has stated its commitment to standardize its multiple, disparate, electronic mail systems on the X.400 standard.

Data which needs to be exchanged in transaction/file transfer and validation is frequently accessed through workstations attached to Local Area Networks (LANs). The data itself is often stored on file servers attached to a LAN. With the worldwide growth of Local Area Networks (LANs) the need to interconnect LANs at multiple locations is also growing. Very cost effective interconnection can be accomplished through the public network utilizing digital central office links. Frame relay technology is particularly suited for LAN to LAN interconnection based on its high throughput capability, from 64 kbps to 2.048 kbps.

The choices of ways of carrying data across networks are rapidly evolving. Transaction/file transfer and validation has generally been provided over leased lines or managed Managed Data Networks Service (MDNS). With the advent of international switched 56/64 kbps services, an opportunity to share data circuits through the public network and cut the cost of private lines or privately managed services has emerged.

The image services portion of information distribution/collection is already quite large and growing rapidly. A great deal of additional growth is expected to take place over the next 5 years. Facsimile has proven the importance of image, as it fills global networks with traffic. It is estimated that 17% of all U.S./European communications traffic is facsimile, while the figure is at least 40% for U.S./Asian traffic (4). As imaging systems are integrated into computer networks over the 1990s, the backroom costs of clearing checks and other financial drafts will be trimmed. This will require the kind of high capacity, inexpensive bandwidth provided by fiber optic systems. These applications are already emerging within specific banks. As the technology proves itself, the applications will be extended to regional bank to bank transactions, and, ultimately, global interaction.

The most advanced of the services banks are beginning to use to improve the efficiency of internal operations is video conferencing. Dial-up video was discussed above (Section 4.2) in the context of improving client relationships It is equally important for use within the bank. This promises to be a major opportunity both for banks as well as for service providers.

Some of the uses multinational banks are beginning to make of global video conferencing include: planning, new product development and rollout, coordination of complex mergers, acquisitions, and consolidations, and meetings of geographically dispersed senior executives. These uses are emerging across many banking segments including retail, wholesale and investment banking. Benefits include the strategic advantage of faster cycle time to market for new products, the ability to better solve and avoid complex problems, and the capture of new opportunities. Equally important is improved ability to build teamwork and cooperation. These benefits translate directly into cost savings and revenue growth.

5. IMPLICATIONS OF BANK MANAGERS OBJECTIVES FOR MULTINATIONAL CORPORATE NETWORKS

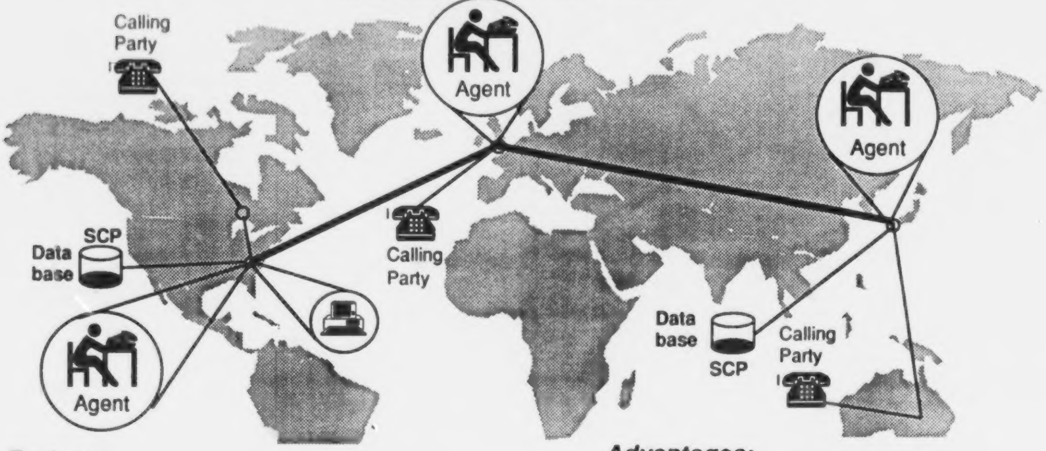
Containment of operating costs, high reliability, availability and serviceability are all traditional areas of emphasis by the PTT/ASP. They are also key telecommunications network requirements of global banks.

However, there are other objectives which must be met by PTT/ASPs to provide the kind of service needed by banks and other multinational corporations today. For example, the corporation can minimize its costs if it can deal with a single point of contact to obtain a global networking service. Design, optimization and operation of international networks are examples of vital services which can be provided by carriers. Such services will help multinational corporations simplify the complexity of maintaining international networks. Some corporations have become accustomed to large in-house staffs to handle such requirements. In this era of cost-cutting, simplification, and outsourcing, PTT/ASP's will find an increasing market for services which address these needs.

Meeting these needs will require some PTTs to respond much more rapidly than they have in the past. One of the inhibitors to obtaining these services from PTTs is the old image of a ponderous organization which is slow to move and does not care too much about customer needs.

International/Regional Network Application

Simultaneous Voice, Data


Calling Party
Agent
Agent
SCP
Data base
Calling Party
Agent
Data base
SCP
Calling Party

Features

- Centralized or Distributed Databases
- Computer Integrated Telephony
  - Calling Line Identification
  - Voice Response Units (Automated Operator
  - Manual Database Access in Rotary Phone Environement
- Calling Party Profile

Advantages:

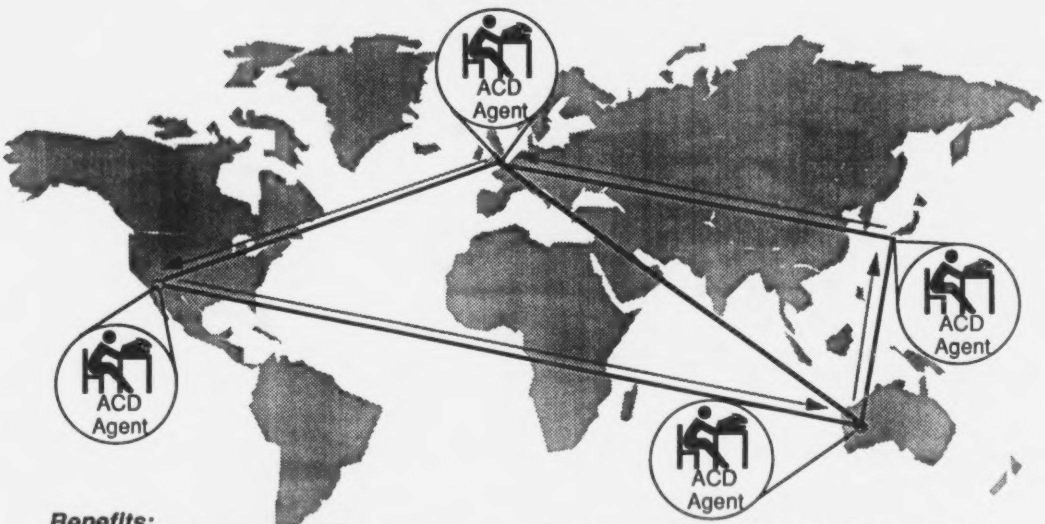
- Decreased Average Working Time
- Improved Customer Service/Sales Effectiveness

Benefits:

- Lower Costs
- Increased Revenue Potential

FIGURE 2

Global ACD Networking

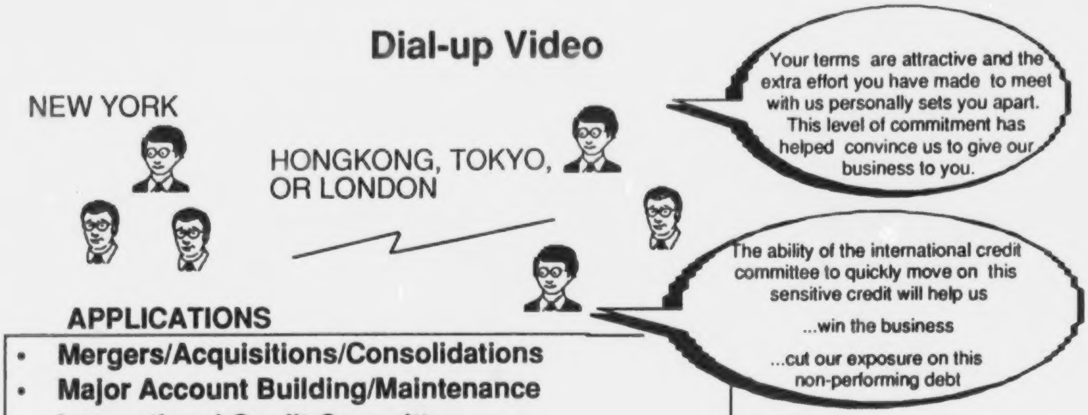

ACD Agent
ACD Agent
ACD Agent
ACD Agent

Benefits:

- Optimize Resources To Reduce Costs & Maximize Productivity
- Improve Customer Service
- Operate Different ACD Groups As One Resource
- Language Support

FIGURE 3

Dial-up Video


NEW YORK
HONGKONG, TOKYO, OR LONDON
Your terms are attractive and the extra effort you have made to meet with us personally sets you apart. This level of commitment has helped convince us to give our business to you.
The ability of the international credit committee to quickly move on this sensitive credit will help us ...win the business ...cut our exposure on this non-performing debt

APPLICATIONS

- **Mergers/Acquisitions/Consolidations**
- **Major Account Building/Maintenance**
- **International Credit Committee**
- **New product development, support and rollout**
- **Internal Operations**

ADVANTAGES

- **Increase personal contact**
  - **Essential in a highly competitive business where personal relationships are key -**
- **Make decisions requiring coordination with key personnel and groups: teamwork**
  - Short notice and regular meetings
- **Integrate visuals with oral presentations (charts, graphs, spreadsheets, etc.)**

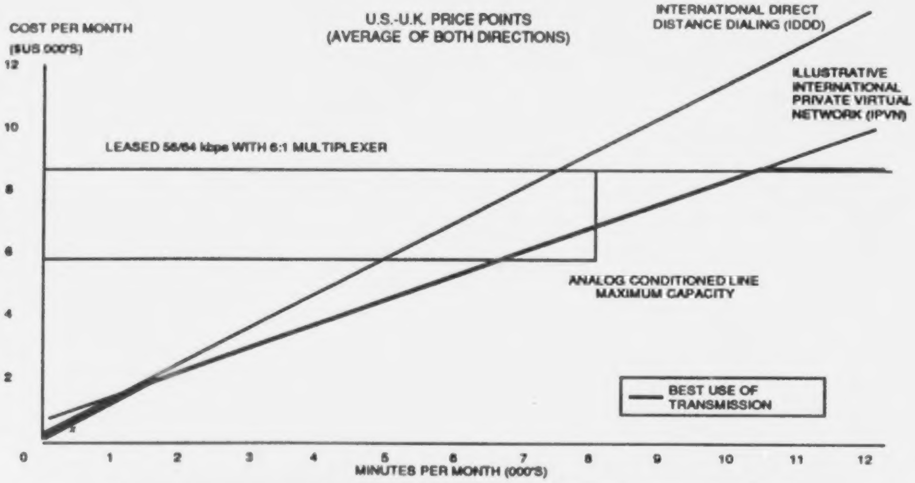
BENEFITS

- **Capture opportunities, avoid neglected problems and possible losses**
- **Avoid wear and tear of travel, time commitment, expense**

FIGURE 4

Transmission Cost

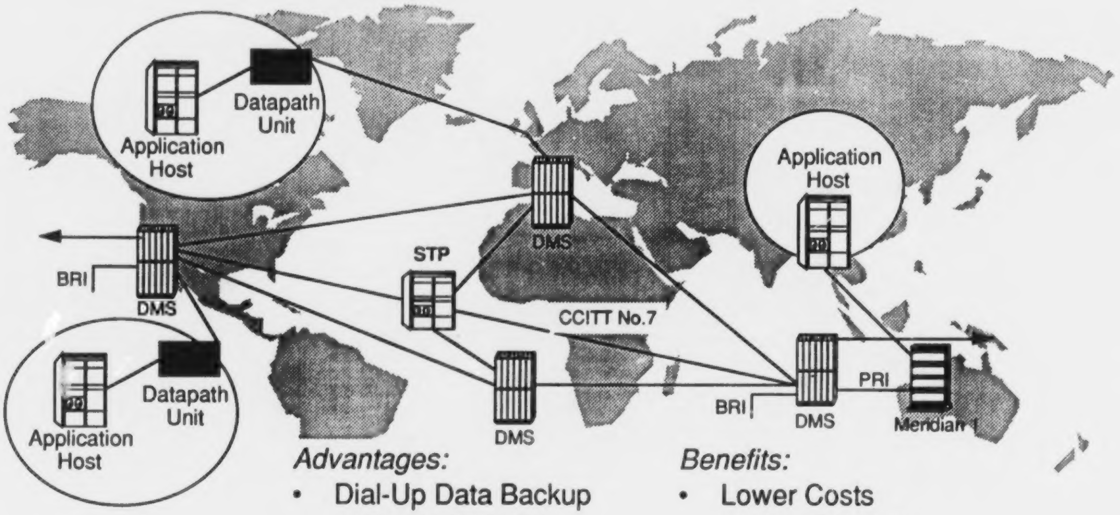
Tariff Analysis



International Networks are Customized to Include a Combination of IDDD, PVN and Leased Lines

FIGURE 5

Disaster Recovery Planning


Application Host
Datapath Unit
Application Host
DMS
STP
BRI
DMS
CCITT No.7
Application Host
Datapath Unit
DMS
PRI
BRI
DMS
Meridian 1

Advantages:

- Dial-Up Data Backup
- Alternate Routing
  - Transmission Paths
  - Switching Centers

Benefits:

- Lower Costs
- Higher Reliabilty
  - Less Downtime
  - Fewer Errors
  - Catastrophe Avoidance

FIGURE 6

Global Networking

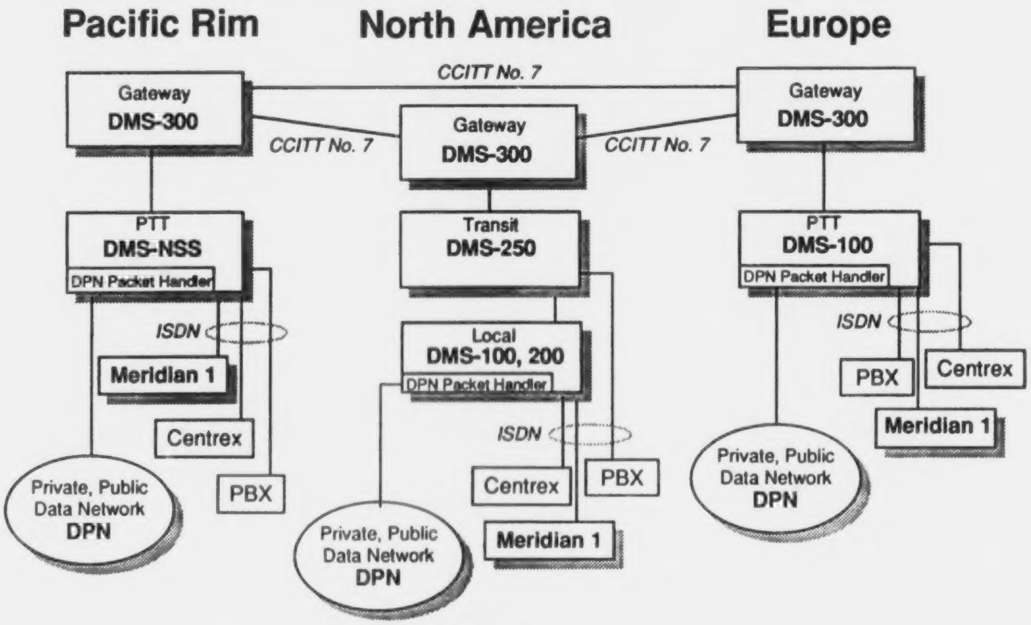

Pacific Rim
North America
Europe
CCITT No. 7
Gateway DMS-300
CCITT No. 7
Gateway DMS-300
CCITT No. 7
Gateway DMS-300
PTT DMS-NSS
DPN Packet Handler
ISDN
Meridian 1
Centrex
PBX
Private, Public Data Network DPN
Transit DMS-250
Local DMS-100, 200
DPN Packet Handler
ISDN
Centrex
PBX
Meridian 1
Private, Public Data Network DPN
PTT DMS-100
DPN Packet Handler
ISDN
PBX
Centrex
Meridian 1
Private, Public Data Network DPN

FIGURE 7

NEW SATELLITE SERVICES FOR ASIA

John D.R. Lawrence
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Hong Kong

1. ABSTRACT

Asia is a continent of extremes. While its modern cities sparkle from the glass of new sky-scrapers, vast rural areas seem locked in time, centuries behind. While businesses in the modern cities enjoy world class computerization and telecom services, thousands of villages do not even have basic telephone service.

The proven benefits of satellite telecom services are now available to every Asian country at internationally competitive prices. As countries seize the opportunity do develop their own satellite networks, the power of satellite technology will quickly start to influence the lives of millions.

2. INTRODUCTION

Asia is a continent of extremes. While its modern cities sparkle from the glass of new sky-scrapers, vast rural areas seem locked in time, centuries behind. While businesses in the modern cities enjoy world class computerization and telecom services, thousands of villages do not even have basic telephone service.

Throughout the last two decades, satellites have provided telephone links between the major cities of Asia and rest of the world. These links played an important role in establishing the infrastructure necessary for economic development. Business has thrived and many of these countries have experienced the world's highest economic growth rates.

Through the 1990's, intercontinental satellite services and new fibre optic links will be important to the continuing success of major Asian cities. However, it will be the satellite technologies of the 1980's, the technologies of private satellite networks, VSAT's and direct-to-home satellite television, which will make the greatest difference to the majority of Asians. The greatest challenge for the coming decade will be to use these technologies to spread the advantages of economic development across Asia.

3. DEVELOPMENT OF SATELLITE SERVICE IN ASIA

Geostationary communications satellites first came into service in the mid 1960's to provide direct telecom links across the Atlantic between Europe and America. Earth stations were large and expensive, so most countries had only one or two stations. The primary role of these satellites was to provide point-to-point telephony service to link national telephone companies.

Intelsat, the world's major satellite consortium, continues to operate its satellites above the oceans and continues to meet the growing demand for international telephony with ever-growing capacity.

In the 1970's the largest countries of the world recognized the benefits of using of satellites to provide telecom service across vast distances. Canada, the United States, the Soviet Union and Indonesia each launched domestic satellite systems to provide national linkages over thousands of miles. At the time that each of these countries began their national satellite service, it was thought that the major use of this service would be long distance telephony, but as capacity on these satellites began to fill, it became clear that television use would dominate.

The development of satellite service in Asia followed the same trends as America and Europe. Intelsat linkages were established across the Indian and Pacific Oceans in 1969, and through the 1970's most Asian countries became Intelsat signatories.

Indonesia, a country archipelago which spreads across three thousand miles of ocean was the first Asian country to establish a domestic satellite system. By the mid 1980's domestic satellite service had begun in Japan, China and India. Following the trend, Intelsat remained primarily a vehicle for international and intercontinental telephony, while the domestic satellites became primarily used for television distribution.

A number of Asian countries, allied to the Soviet Union, used the Soviet Intersputnik system for international communications. Mongolia, North Korea, Vietnam, Laos and Cambodia each established satellite links through Intersputnik to Eastern Block countries, but became ever more isolated from the rest of the international community.

The thaw in East-West relations over the last couple of years has had significant impact on satellite use of these Asian countries. Vietnam is now using Australian equipment installed by Australia's Overseas Telecom Corporation (OTC) to link through Intelsat to the rest of the world and similar services are also being installed in Laos and Cambodia. Mongolia is now using AsiaSat to link telephone service to Hong Kong and through Hong Kong to Europe and America.

4. NEW TELECOM SERVICES

Most Asian countries have enjoyed a decade of solid economic growth. This growth has created ever-greater demands for communications services and terrible pressure on Asian governments to meet these demands. As if to complicate the problem, new telecommunications technologies are creating new alternative solutions. Faced with the challenge of choosing the best telecom technologies, Asian countries look to the experience in Europe and America.

The developed economies have shown that there is not one simple solution but, if market forces are allowed to operate, each technology can play an useful role. While fibre-optic cable has proven itself as a solution to establish the backbone of a telephone network, cellular telephone has proven useful to those who will pay extra for the convenience of continuous mobile access to the telephone network. Other technologies such as cable television and satellite television succeed in their own market niche and provide complementary services.

Domestic satellite service is now available to every Asian country either through the national satellites of Indonesia, Japan, China and India or through the regional satellites Arabsat and AsiaSat. This service is ideal for trunk line capacity between major cities, for private VSAT data networks and for rural telephony.

Point-to-point satellite links between major cities can establish important national telephone connectivity more quickly and at lower cost than terrestrial microwave or fibre optic cable. With higher-powered C-band satellites linkage between two Asian cities can be estalished with two 7-metre earth stations providing over 1000 continuous voice circuits. As demand for circuits grows, terrestrial solutions may prove to be more economic, but the installation of a satellite link will still be a valuable asset as security against failure of the terrestrial links and for future periods when the terrestrial network becomes overloaded.

While Asian countries build new digital telecom networks, the established analogue networks are becoming even more congested. Many businesses find it hard to wait for quality telecom service. One solution is satellite-based Very Small Aperture Terminal (VSAT) networks which can establish direct digital linkages between business sites. This service is specially attractive to banks, hotel chains, airlines and oil companies who need a continuous reliable digital link between many national offices.

In the last two years, new VSATs networks have been established in Japan, China, India, Indonesia and Thailand. New VSAT networks are now being built in Pakistan, South Korea and Taiwan while many other nations are studying this possibilities.

With the exception of Japan, South Korea and Taiwan, Asian VSAT networks are being established with high powered C-band satellites. Manufacturers from North America, Europe and Japan are competing for this emerging market, while China has established its own VSAT manufacturing capability.

With C-band satellites delivering power levels of 34-38 dBW, EIRP, the typical Asian VSAT network is designed with 1.8 metre to 3 metre remote stations linked together through a 7 metre hub station. This provides a direct digital link of one to four voice or data channels.

5. RURAL TELECOMMUNICATIONS

More than 70 percent of Asian people live in rural areas. The challenge of providing telecommunications service to these people is compounded by the often rugged geography of Asia

Satellites are uniquely suited to providing telecoms service to remote communities and the latest VSAT technologies offer new economical solution for rural telephony. A single national hub station can control a full mesh network, and through the use of Demand Assigned Multiple Access (DAMA) technology, hundreds of remote sites can be connected through one satellite transponder.

AsiaSat has prepared a preliminary design for a rural telephone network in the Pakistan province of Baluchistan. This network includes 45 cells each covering an area of approximately 90 Kilometers in diameter. A terrestrial radio system provides communications within a cell, and a 3.7 metre earth station at the middle of the cell provides seven to twelve 32 Kbit voice circuits to the provincial hub and into the national and international switched network. An additional seventy, 2 metre terminals provide single circuit capacity to the most remote sites within the network.

This design shows how a major rural telecom network can be installed quickly and economically to improve the lives of thousands of people.

6. TELEVISION VIA SATELLITE

In 1977 an international conference of satellite experts agreed that each country should be allocated an orbital location to launch high-powered direct broadcast satellites (DBS). These satellites would deliver television to small home satellite receivers.

In the last fourteen years DBS has proven to be technically feasible and commercially disastrous. The recent failure of British Satellite Broadcasting (BSB) is only the latest in a series of DBS commercial failures.

While many Asian countries, including China, still look to DBS technology for future television broadcasting, few have fully understood the economic realities that have revolutionized satellite television since the 1970's. As Asian countries enter the 1990's it becomes increasing important for leaders to understand how much this industry has changed.

In 1979, the Christmas Catalogue of the upmarket Nieman Marcus Department Store in America, included an US$80,000 home satellite television receive-only system (TVRO). Ten years later a technically superior TVRO was manufactured and installed in India for US$800. In ten years expensive American state-of-the-art technology has become inexpensive and common in the third world.

Now that C-band and Ku-band satellite TVRO's are consumer products, the number of dishes that will be installed will depend more on the number of programs available than the size of the antenna. Over most of Asia, C-band dominates the market for satellite television primarily because large C-band footprints provide national satellite television service to the large Asian countries such as China, India and Indonesia. Smaller countries share C-band satellites that provide national coverage because this is significantly less expensive than launching domestic Ku-band satellites, and because this will provide TV service to nationals living in neighbouring countries.

AsiaSat-1 will be the first choice for major international satellite broadcasters because it provides higher-powered C-band signals across all 38 Asian countries. The market for these services will be English-speaking nationals, expatriates and international hotels. There may also be a valuable market for Japanese-speaking expatriates in many Asian countries.

7. SATELLITES FOR ASIA

Having described the benefits of satellite services for Asian telecommunications and Asian broadcasting one question the remains unanswer, "How do Asian countries get access to satellite capacity?". There are probably three answers to this question. The first answer is launch a satellite, the second answer is use a neighbouring country's satellite and the third answer is share a regional satellite.

Launching a domestic satellite system has proven to be the most expensive solution. The political gains that are realised by having an unseen flag in space are often tarnished by the enormous cost of domestic satellite system.

Using the satellite of a neighouring country has often been the lowest cost option but this option seldom provides secure service. The host country usually retains full rights to satellite capacity and therefore only offers preemptible service that can be cancelled without notice.

AsiaSat-1 was launched in April 1990 to provide shared domestic satellite services to Asian countries at competitive world prices. The concept of holding contracted non-preemptible service on a privately financed regional satellite has proven to be attractive to broadcasters and telecom companies in many Asian countries.

8. CONCLUSION

The proven benefits of satellite telecom services are now available to every Asian country at internationally competitive prices. As countries seize the opportunity do develop their own satellite networks, the power of satellite technology will quickly start to influence the lives of millions.

Domestic satellite service, with higher-powered C-band capacity, will be one of many technologies that will help build the future telecoms infrastructure in Asia. Experience in North America shows that domestic satellites can provide many economical solutions including VSAT networks and television distribution. It can be expected that this North American experience heralds great opportunities for Asia.

Through the 1990's new technologies will present new opportunities. Asian countries select the technologies that meet their requirements today and remain flexible for the changes of the future. Who can guess which item in this years Neiman Marcus calendar will have a ninety-nine percent price reduction by the year 2000.

INMARSAT Applications in the Pacific Rim

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1. ABSTRACT

INMARSAT service applications have been greatly expanded from the early days of 1976 when COMSAT developed and introduced its MARISAT system. Today, the satellite organization has 9 satellites in orbit, including the recently launched second generation satellite, and is able to provide substantially greater capacity to accommodate the requirements of an increasing user community. These requirements include not only new services such as full period voice broadcasts, but also new applications for old services. INMARSAT has also expanded the technical standards which afford users new types of remote terminals, including the aeronautical community and both maritime and land mobile users who can employ the new Standard C technology. This expansion, accompanied by implementation of the long-awaited four region system, establishes a new threshhold for new applications, many of which will serve the Pacific Rim region well.

2. INMARSAT

2.1 ORGANIZATIONAL BACKGROUND

After three years of study and negotiation by the INMARSAT PREPARATORY COMMITTEE, the International Maritime Satellite Organization came into being on July 19, 1979. The first Director General was Mr. Olof Lundberg, who was recently reelected to a third six-year term as the head of the Organization. Today, sixty-two countries belong to INMARSAT (see Table 1), and the Organization has nine satellites in its network, including the first of its second-generation spacecraft (Table 2). Recently, the configuration of the space segment was realigned to inaugurate service to the fourth ocean network, the Atlantic Ocean Region-West, and thereby achieving global coverage (Figure 1). As of December 1, 1990, there were twenty-three coast earth stations operating in the system from fifteen countries, and another sixteen stations planned for operation by the end of 1991 (see Table 3.)

2.2. ORGANIZATIONAL STRUCTURE

Like its sister organization, INTELSAT (International Telecommunications Satellite Organization), INMARSAT consists of member states which are the Parties which have signed the INMARSAT Convention and constitute the ASSEMBLY, which meets biannually to review the general direction of the Organization. Each Party names a Signatory which has the responsibility for the financial and operational responsibilities associated with that country's participation in the Organization. There is also a COUNCIL, the policy and decision-making body, which consists of twenty-two members representing the eighteen largest investor Signatories (or groups of Signatories) plus four at-large members elected by the ASSEMBLY. The COUNCIL also has several committees which report to it and have responsibility for studying certain aspects of the Organization's activity and making recommendations to the COUNCIL. Three standing committees are the ACTOM (Advisory Committee on Technical and Operational Matters) and the Finance Committee plus the Traffic Planning Committee.

3. STANDARDS AND SERVICES

3.1 STANDARDS

One of the more important aspects of creating an organization such as INMARSAT is that it provides the opportunity for agreeing on international standards for service. This action creates the opportunity for the development of competition for equipment on a global basis, which has the effect of reducing the cost of equipment for end users.

The initial technical standard for operation in the INMARSAT system was the Standard A ship earth station (SES), which was developed by COMSAT for its MARISAT (Maritime Satellite) System, the predecessor of the INMARSAT system. The Standard A SES is capable of providing virtually any telephony service, including facsimile or data transmission, telex, and a variety of broadcast or group call services. At the end of 1990, almost 13,000 terminals of this type were commissioned to operate, with over 1500 authorized to operate from land locations. Figure 2 shows the growth in Standard A terminals from inception by COMSAT in 1976 to the end of 1990.

At the end of 1990, INMARSAT was preparing to begin its new Standard C service. The Standard C terminal, due to its small size and versatility will enable a number of new applications to be filled. This standard enables the transmission of data at speeds of 600bps through the satellite system on a store and forward basis. This technology has been accepted by the International Maritime Organization (IMO) as capable of fulfilling the carriage requirements for vessels needing to comply with the Global Maritime Distress and Safety System (GMDSS) regulations. During 1990, INMARSAT conducted a demonstration

Table 1. INMARSAT MEMBER STATES AND INVESTMENT SHARES AS OF 23 OCTOBER 1990

COUNTRY	SHARE %
United States	24.92530
United Kingdom	13.77205
Norway	11.97100
Japan	9.27008
France	4.22325
USSR	3.71886
Greece	2.92019
Netherlands	2.54238
Denmark	2.54114
Germany	2.43313
Italy	2.14743
Singapore	2.13184
Spain	1.98365
Saudi Arabia	1.89856
Canada	1.64507
Australia	1.63185
Brazil	1.48773
Sweden	0.88857
Belgium	0.73688
Poland	0.68293
Korea, Rep. of	0.67756
Kuwait	0.52708
Finland	0.45316
India	0.44020
Switzerland	0.43542
China, People's Rep. of	0.31192
Portugal	0.26836
Iran	0.25011
Indonesia	0.23743
United Arab Emirates	0.23154
Argentina	0.19795
Egypt	0.19716
Bulgaria	0.19557
New Zealand	0.18691
Liberia	0.15471
Malaysia	0.14866
Philippines	0.12268
Bahrain	0.11954
Qatar	0.09758
Monaco	0.09731
Panama	0.07477
Turkey	0.07477
Gabon	0.06825
Chile	0.06675
Pakistan	0.05968
Sri Lanka	0.05304
Algeria	0.05000
Cameroon	0.05000
Colombia	0.05000
Cuba	0.05000
Czechoslovakia	0.05000
Iraq	0.05000
Israel	0.05000
Mozambique	0.05000
Nigeria	0.05000
Oman	0.05000
Peru	0.05000
Romania	0.05000
Tunisia	0.05000
Yugoslavia	0.05000
TOTAL	100.00000

service with about 1000 vessels, testing the efficiency and effectiveness of the Standard C service, albeit under restricted conditions.

The newest service, aeronautical satellite service was also introduced in 1990, with COMSAT starting its data service in September in the Pacific Ocean Region, and telephone service being introduced in the Atlantic Ocean Region by another of the Signatories. These actions now permit many of the same types of communication as have been available to ships since 1976.

The INMARSAT Organization is also developing additional standards for communication, planning future replacements for the Standard A analog voice system, thereby permitting more efficient use of the space segment capacity, and enabling more users to take advantage of the system's capabilities. These new standards, identified as B and M, will permit communications at lower costs. A comparison of the technical characteristics of the various INMARSAT standards is presented at Table 4.

3.2 SERVICES

Due to the relative newness of the Standard C and Aeronautical Services, the provision of Standard A service has been, and for some additional future period will be, the bread and butter service of the INMARSAT Organization. Traffic growth from 1976 through 1990 for telephony and telex services for Standard A are shown in Figure 3. Of interest is that the growth rate of telex service is waning, due to the availability of more cost-effective data communications over telephony channels through use of facsimile and computer-to-computer transmissions. Of the total communications passed through INMARSAT in 1990, the Atlantic Ocean Region accounted for almost 50 percent of traffic, and the Pacific and Indian Ocean Regions handling the balance, with the Indian Ocean Region slightly higher than the Pacific. Although the Atlantic Region is now split into East and West, there is yet insufficient information to permit an understanding of the demand requirements between the two.

The Standard C terminal, due to its small size and versatility will enable a number of new and needed applications to be filled, particularly in the Pacific Region. The problem of developing a cost effective means for vessel monitoring and tracking will permit agencies such as the U.S. Coast Guard to establish safeguard systems which will assist in preventing future oil spills and collisions of ships. Another reporting application will be that of monitoring the driftnet fishing vessels and ensuring that they stay within designated fishing areas. This capability will enable the U.S. government to review the requirements for its ARGOS satellite system, and permit its use for other needed applications, or perhaps even enable the government to reevaluate the need to continue funding the program if other commercial systems are available to provide service. The use of tracking and monitoring

Table 2. INMARSAT SPACE SEGMENT

Satellite	Owner	Region	Location	Ckts	Status
MARISAT F-1	COMSAT	AOR	106.5W	10	Spare
MARISAT F-2	COMSAT	IOR	72.5E	10	Spare
MARISAT F-3	COMSAT	POR	176.5E	10	Spare
MCS-A	INTELSAT	IOR	63.0E	42	Spare
MCS-B	INTELSAT	AOR	18.5W	42	Operational
MCS-D	INTELSAT	POR	180.0E	42	Operational
MARECS A	ESA	POR	178.5E	80	Spare
MARECS B-2	ESA	AOR	55.5W	80	Operational
INMARSAT 2,F-1	INMARSAT	IOR	64.5E	120	Operational

FIGURE 1. INMARSAT FOUR OCEAN REGION GLOBAL NETWORK

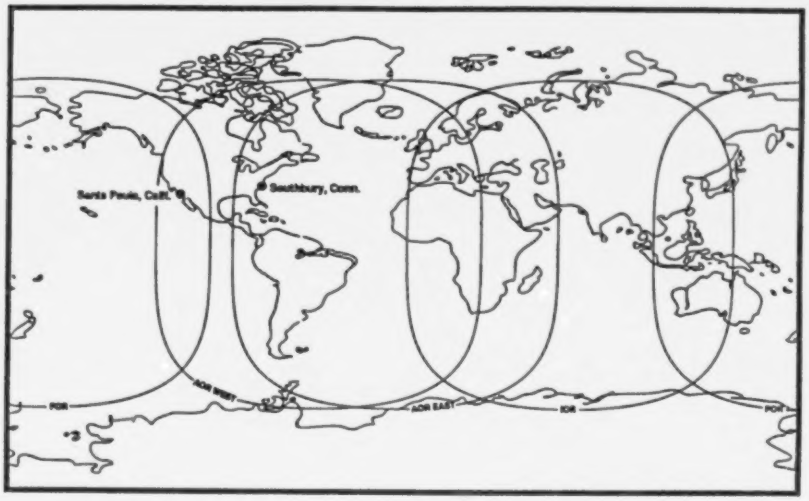

Table 3. INMARSAT COAST EARTH STATIONS

	AOR-E	AOR-W	IOR	POR
Existing	USA	USA		USA
	USSR		USSR	USSR
			Japan	Japan
			Australia	Australia
	Poland		Poland	
	Turkey		Turkey	
		UK		
	Brazil			
	France			
	Italy			
	Kuwait			
	Egypt			
			Greece	
			S.Arabia	
				Singapore
Planned 1991	USA	USA		USA
			China	China
			Singapore	
				Korea
		Brazil		
		Canada		
		France		
	Denmark			
	Germany			
	Netherlands			
	Norway			
	Spain			

FIGURE 2. INMARSAT SHIP EARTH STATIONS

STANDARD A 1976–1990

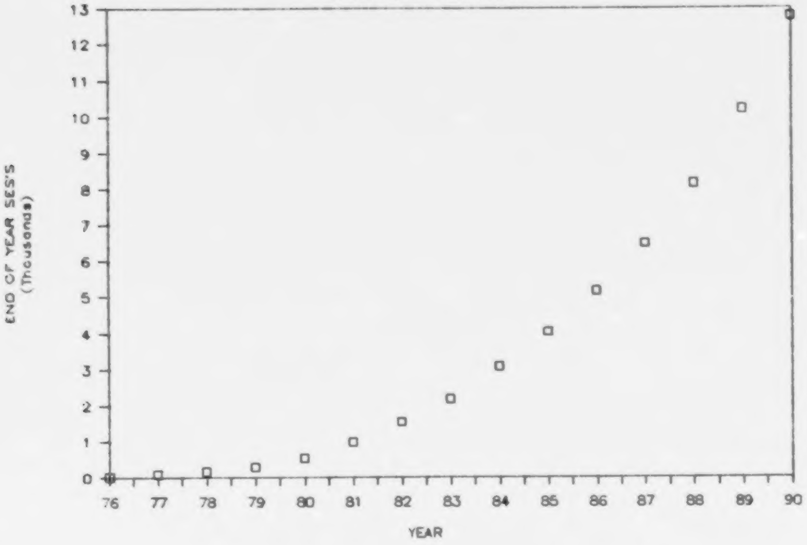

FIGURE 3. INMARSAT TRAFFIC

1976–1990

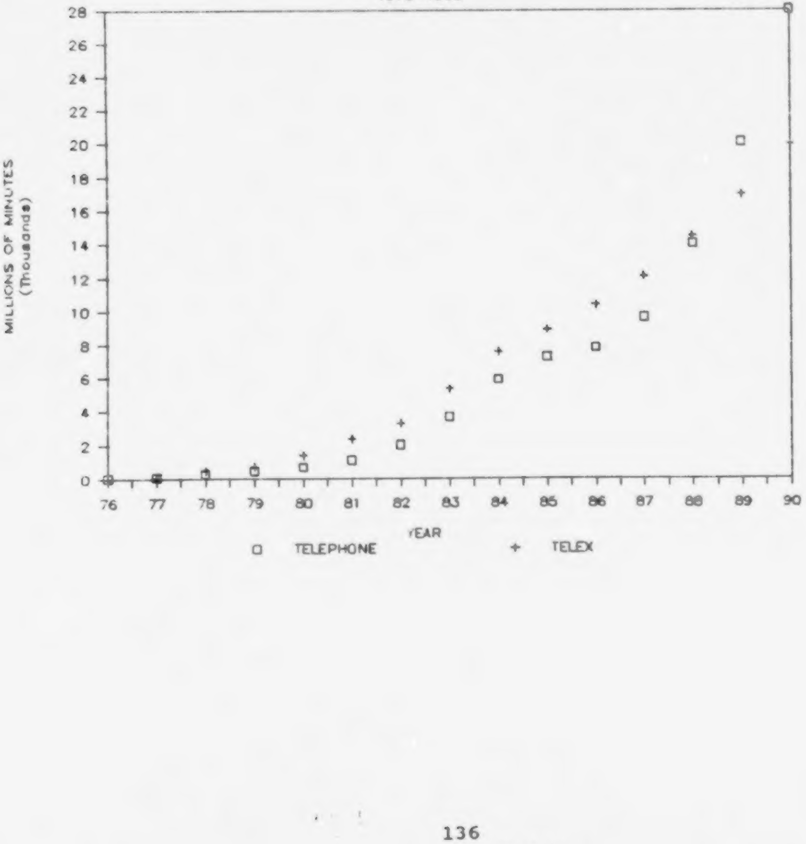

Table 4. TECHNICAL CHARACTERISTICS OF INMARSAT STANDARDS

					Aeronautical	
	Std A	Std B	Std M	Std C	High	Low
Type of Comm.	Analog	Digital	Digital	Digital	Digital	Digital
Antenna Type	Direct.	Direct.	Direct.	Omni	Steered	Omni
Avg Sat Power						
Return	-7dBw	-10dBw	-12dBw	-24dBw	-9	-18
Forward	15dBw	12dBw	22dBw	21dBw	16dBw	21dBw
Capabilities:						
Voice:						
Bandwidth	30kHz	20kHz	10kHz	N/A	20kHz	N/A
Data Speed	N/A	16Kbs	4.8Kbs	N/A	9.6Kbs	N/A
Quality	Excel.	Excel.	Good	N/A	Excel.	N/A
Data:						
Max Rate	9.6Kbs	9.6Kbs	2.4Kbs	600bps	10.5Kbs	2.4Kbs
Reliable	2.4Kbs	4.8Kbs	1.2Kbs	600bps	2.4Kbs	300bps
Fax Qual.	Accept	Excel.	Good	TBD	Excel.	N/A
Packet Qual.	Excel.	Excel.	Excel.	Excel.	Excel.	Excel.
End User Costs(U.S.$):						
Terminal Price	25-30K	40-50K	15-20K	5-7K	500K	300K
Telephony/Min.	7-10	5-6	5-6	N/A	6-7	N/A
Telex/Min.	4-5	4-5	N/A	4-5	N/A	N/A
Data/Kbit	N/A	N/A	N/A	1	<1	<1
Downlink	15dBw					

can also be expanded to land-based vehicles. In much of the world, users such as trucking fleet operators have a need to better monitor the activity of their vehicles, for both operational and emergency purposes. Systems are now being developed and employed to assist in establishing hi-jacking deterrents.

Another use of the new Standard C technology is in SCADA (Supervisory Control and Data Acquisition) activities. SCADA applications include monitoring of oil pipelines, utility networks, air and water pollution, and other areas. Information can be obtained by automatic reporting or through polling of remote terminals. Somewhat related to SCADA is the use of the Standard C system for collection of weather data for use in forecasting.

The Standard C system lends itself readily to both open and closed networks. Unlike most other competing systems, the INMARSAT system's open architecture permits communications to be easily sent off-net, to any place in the world, and via a number of different technological interfaces--telephony, telex or packet.

Combinations of technologies can also be employed by users. For instance, many of the objectives of the PEACESAT project can be achieved by combining the Standard A voice broadcast capability developed for the Armed Forces Radio and Television Services with the two way communications capability of the Standard C terminal, wherein queries or responses from remote locations can be sent to a single or to multiple stations in a network serving educational or public service groups, all at a minimal investment cost.

Obviously, the development of new standards and services, coupled with traffic growth, impacts the space segment capacity required by the INMARSAT Organization. As stated earlier, launch of the second generation satellites has already begun, and in expectation of continued growth, INMARSAT has recently contracted for procurement of a third generation satellite system, which will incorporate features which will permit further improvements in efficiency of resources and enable additional new services to be offered. Recently, a differential GPS service was introduced which permits greater precision than previously available to users who have high accuracy requirements. The forthcoming third generation satellite will enable the transmission of GPS (Global Positioning Service) integrity information through the use of spread spectrum broadcasts, thereby enabling general aviation and other users to have much more accurate information than ever before for use in their navigation.

4. CONCLUSIONS

The INMARSAT system has proven to be versatile, enabling a number of disparate users to achieve economic communications on a global basis using accepted international standards. The opportunity to extend applications of existing and new services to user groups in the Pacific region will permit opportunities for improving the quality of life and development for the countries in the region. As is the case with most communications technologies, further applications will come forth and make the services even more valuable.

5. REFERENCES

Slack, Edward R., "International Land Mobile Satellite Service Applications and Markets", COMMTEL '90 Conference, Hong Kong, Dec. 6-7, 1990.

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Inmarsat-C
Mobile Earth Stations in Developing Countries
Some Commercial Initiatives

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ABSTRACT

Current trends point to major growth in demand for mobile satellite communications. Based on conservative forecasts, a vast user population is expected by the year 2000 with a significant share located in developing countries. A number of mobile satellite communications applications can be very beneficial to developing economies. In many situations, the benefits may far outweigh the costs. The ability to support the capital and operating costs for the use of such systems are much greater than normally accepted if entities in the public domain are included. The manufacture of mobile satellite terminals promises to be a business of major magnitude. The adoption of a consortium approach to local production of equipment could enhance the risk/reward ratio for such undertakings, and may be worthwhile exploring.

INTRODUCTION

A portable satellite data terminal that can be used around the world, providing store and forward data messaging services to users, is now available. This is the Inmarsat-C Mobile Earth Station (MES) which went into commercial service in November 1990. The market for the service is expected to increase rapidly. Cost per terminal is now about US$5,000 but is expected to fall to US$2,500 by 1995.

Given the low start-up cost and the fact that service can be available almost as soon as the equipment is purchased, the new terminals are particularly suited to areas where the communications infrastructure is underdeveloped. For business executives who must travel to those areas, productivity could be significantly increased by such a tool.

The Inmarsat-C service is offered by Inmarsat, an internationally-owned cooperative which provides worldwide mobile satellite communications.

Established in 1979 to serve the maritime community, Inmarsat has since evolved to become the only provider of global mobile satellite communications for commercial and distress and safety applications, at sea, in the air and on land. Headquartered in London, UK, Inmarsat now has 62 member countries. The government of each country is a "Party" to the Convention which establishes Inmarsat, and each Party nominates a "Signatory" to represent its commercial interests in the organization. Membership is open to any country.

Inmarsat provides global coverage for mobile satellite communications via geostationary satellites. The first generation satellites is being replaced by higher capacity, second generation. The first of these satellites was successfully launched on 30 October 1990 and is now in operation over the Indian Ocean Region. The remaining three satellites in the second generation series are to be launched during 1991. The Inmarsat-C MESs, through the Inmarsat satellites and Inmarsat Signatory-owned Land Earth Stations (LESs) can interwork with terrestrial data networks. In the Asia-Pacific region, service is now available through the Australian Perth Station to be followed by the Singaporean LES and in mid-1991 by the US Santa Paula and the Chinese Beijing LESs. All of these LESs provide services such as store and forward message transfer protocol permitting telex service to and from MESs; the Enhanced Group Call protocol permitting SafetyNet$_{TM}$ services; and maritime distress alerting protocol, meeting Global Maritime Distress and Safety System (GMDSS) requirements. Some offer optional services such as polling protocol providing individually-directed, group-directed and area-directed services; data reporting protocol, providing position reporting, fleet management and Supervisory Control And Data Acquisition (SCADA) services; and a group call service FleetNET$_{TM}$.

MARKET SIZE

The potential market for the Inmarsat-C mobile type terminal is huge since the size and flexibility of the terminal permits a vast variety of communication applications. Significant opportunities exist in equipment and service sales for manufacturers who act early and who undertake strategic investments for volume production. The potential benefits in manufacturing Inmarsat-C terminals or in customizing such equipment for specific applications are strong and they are explored below.

Professional Travellers

Market research indicates that some 50 to 60 million people travel professionally worldwide, spending a considerable amount of time outside the office. For many such people, a briefcase-sized satellite terminal which can be used anywhere to communicate back to the headquarters will be an invaluable tool. They would likely be willing to pay an appreciable premium for the convenience, privacy and customized applications that are possible using Inmarsat-C. The relatively price-inelastic behaviour of these users can be explained by the fact that 20 per cent of them, or 12 million users, are on company expense accounts and productivity and efficiency are important to them.

Thin Route Communications and Remote Monitoring and Control

Many remote communities in the world have no communications infrastructure and are cut off from the public communications network. A shared satellite terminal in such communities can offer inhabitants essential medical, educational, banking and other services in addition to emergency communication facilities.

Supervisory Control And Data Acquisition (SCADA) is a term that is used to describe a variety of remote monitoring and control systems. Such systems include, for example, automatic collection of meteorological data and pipeline monitoring in remote regions. Sensors measuring temperature, rainfall, wind speed and direction may be interrogated periodically and the data sent to a central point for analysis.

Together, SCADA applications translate to some 5 million potential sites throughout the world that could be served cost-effectively by Inmarsat-C terminals.

Trucking

Trucks engaged in long distance road haulage likely to fit mobile satellite communications are measured in tens of thousands worldwide. For many transport operations, total solutions combining hardware and software are important and suppliers should be able to develop long standing and mutually beneficial relationships with them if cost-effective solutions can be developed. Fleet management, position reporting and anti-theft systems are just a few examples of mobile services for the long distance transportation sector.

A significant population of vessels at sea will also find Inmarsat-C useful as a backup to their current Inmarsat-A system or, as a primary mode of communications for smaller operations.

In summary, a very large user population measured in millions, could benefit from mobile Inmarsat-C terminals in both land and maritime environments.

FAVORABLE TRENDS

While it is generally accepted that developing countries can benefit significantly from the use of mobile satellite communications for many applications, the problem of affordability is often cited as an inhibiting factor. There is also concern about the issue of bypassing existing terrestrial facilities operated by the national PTTs. There are, however, other benefits worth noting:

Broad Economic Trends

With the rapid improvement of international travel and communications, small to medium-sized companies are finding it easier and sometimes more profitable to add an international dimension to their business. Such international linkages are increasingly associated with developing regions of the world. Recent shifts in many countries to market economies mean that more emphasis is likely to be placed on the economics and merits of new applications rather than on historical precedence.

Mobile Satellite Terminals of a Fixed Service Provider

Multinational companies have been expanding business operations significantly in recent years. In meeting their international communication needs, they have used increasingly sophisticated methods.

Shared message switches located at PTT offices have evolved over time to include privately-owned switches with leased lines and private communications networks which could offer value-added services to associates and customers. Such impressive developments are driven by global communications demands and by the need to reduce costs. For small to medium-sized companies, the use of technology such as Inmarsat-C may offer cost-effective solutions in extending global coverage and providing customized services at affordable costs.

In developing countries, the issue of bypass may be less significant where the infrastructure for fixed communications is very poor. In such circumstances, mobile satellite terminals may prove to be beneficial for a number of reasons:

a) such facilities offer services immediately with relatively low capital cost;
b) they require virtually no local infrastructure;
c) the use of such facilities to meet user demands improves the image and responsiveness of the PTT while keeping customers satisfied;
d) once service becomes available, user demand and cashflow through earned revenues can be built up over time, making it viable to invest in fixed service facilities earlier than perhaps otherwise possible; and
e) mobile satellite terminals can be relocated to another location, after fixed facilities are installed at the original site, so as to repeat this beneficial cycle once again.

Communications operators are increasingly accepting the facilitating role played by mobile satellite communications in the expansion and provision of fixed services.

Affordability in Developing Countries

While the question of affordability of services by the general population in developing countries is an issue, it may be a totally different matter when the target users represent government entities who may have access to grants and other sources of funding. For such official users, what is required are cost-effective solutions where the case for using mobile satellite communications is clear and indisputable. Once official users adopt such a facility, the affordability threshold for other specialized mobile users in the country may well diminish.

Liberalisation of Regulation

With a growing number of customers around the world, Inmarsat is well aware of the need for regulations which allow mobile satellite terminals to be used in transborder applications. Regional and international meetings have taken place to address the issue. Other meetings are planned to further improve the regulatory environment for use of mobiles. The CEPT (Communaute European des Postes et Telecommunication) countries are seriously considering a recommendation which allows Inmarsat Land Mobile typed approved terminals bearing an explicit label to roam freely in the CEPT countries. A similar ruling is being considered within the Gulf Cooperation Council states. It is Inmarsat's expectation that regulations on the use of satellite mobiles will be considerably freer by 1995.

SUMMARY AND CONCLUSION

Market research shows a significant potential user base for mobile message communication. Even if a small percentage of potential users install satellite equipment, at an average cost of $3500 each, it would lead to an equipment market in excess of $1 billion by the year 2000. It is also shown that use in developing countries will increase over time with Asia's share increasing from 13% to 22% of all users by the end of the century.

Major users are likely to include water authorities, forestry and public security related departments. Within countries like Brazil, India and China, the utility of Inmarsat-C terminals in flood and water control, as examples, is well recognized. If indigenous production of Inmarsat-C mobiles can be realized, the cost of the venture could decrease significantly. Local production could be achieved for example, through a user/manufacturer consortium, where a large local user could underwrite a sizeable initial quantity of terminals at a negotiated purchase price per terminal with a local manufacturer, probably with some participation by foreign manufacturers. This approach would help reduce the risk. If low cost and volume production can be achieved, exports to other markets would also be possible. A 10% share of the market would represent a US$140 million business, not including after-sales support and software sales, which could also be developed.

An active project, based on the broad commercial lines indicated above, is currently in progress in China.

Mobile satellite services offer the opportunity for creating communications links where they are most needed without the necessity for large-scale investments in infrastructure.

Programmes need not be large to be effective. There is merit in modest beginnings and in experimental projects. The flexibility of mobile satellite communications is such that useful applications can be developed with a single terminal. With a trial application, valuable local experience can be gained and the potential of the technology explored at minimal cost. Even a modest initial project can soon become a valuable test bed and foundation for future growth.

A Period of ISDN is Coming Now

Kazuaki Takahashi
and
Yasuhiko Ueno

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Japan

Nippon Telegraph and Telephone Corporation provides ISDN services with basic interface service from 1988 and primary rate interface service from 1989. The basic interface service offers two 64Kb/s (B) channels for information and one 16Kb/s(D) channel for signals. The primary rate interface service offers either 23 or 24 (B) channels for information transmission and one 64Kb/s(D) channel will be provided for signals. In Japan, the basic interface service is called INS 64 and the primary rate interface service is called INS 1500. In here, when we combine 6 channels, it makes 384Kb/s transmission and when we combine 24 channels makes 1.5Mb/s. These two interfaces are in shown in (1).

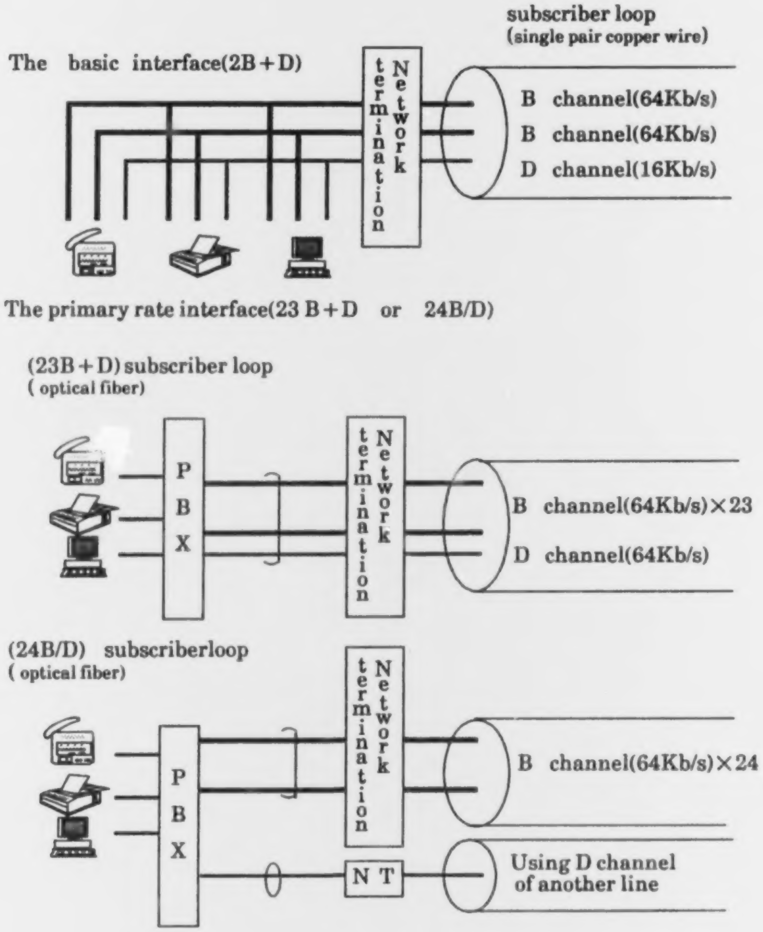
I would like to introduce our agents' network systems(2). Facsimile store (s/f) is used by them to broadcast the buying and selling information of flexible stocks and bonds to all branches at the same time. The purpose of setting this Facsimile store (s/f) in Tokyo and Osaka is to receive a larger volume of business information from host-computer and from 200 facsimiles in all the branch offices. It is possible to send information to all branch offices at the same time. It will automatically resend information if the line is busy. Facsimile store (s/f) can confirm the past record of documents. The document of correspondence shows the page-number, date, time, etc. Super high speed digital circuits are funded in between TDMs'. Private branch exchanges are established in 4 main branch offices through by ISDN service.

The reasons why ISDN service is used by this securities company is that it is less expensive and more efficient compared with other telecommunication systems. The running cost has decreased about three hundred thousand US dollars in each year using ISDN services when compared with DDX-C. For example, if we use INS1500 (the primary rate interface service) within 1.5Mb/s transmission, it can send one hundred thousand Chinese characters, which is about 5 pages of newspaper. From this, we can assume that the correspondence cost can be reduced substantially. For example, the public circuit (4,800b/s) takes about 40 minutes to send and costs US$22, when INS1500 (the primary rate interface service) takes 8-seconds to send and it costs only US$.80.

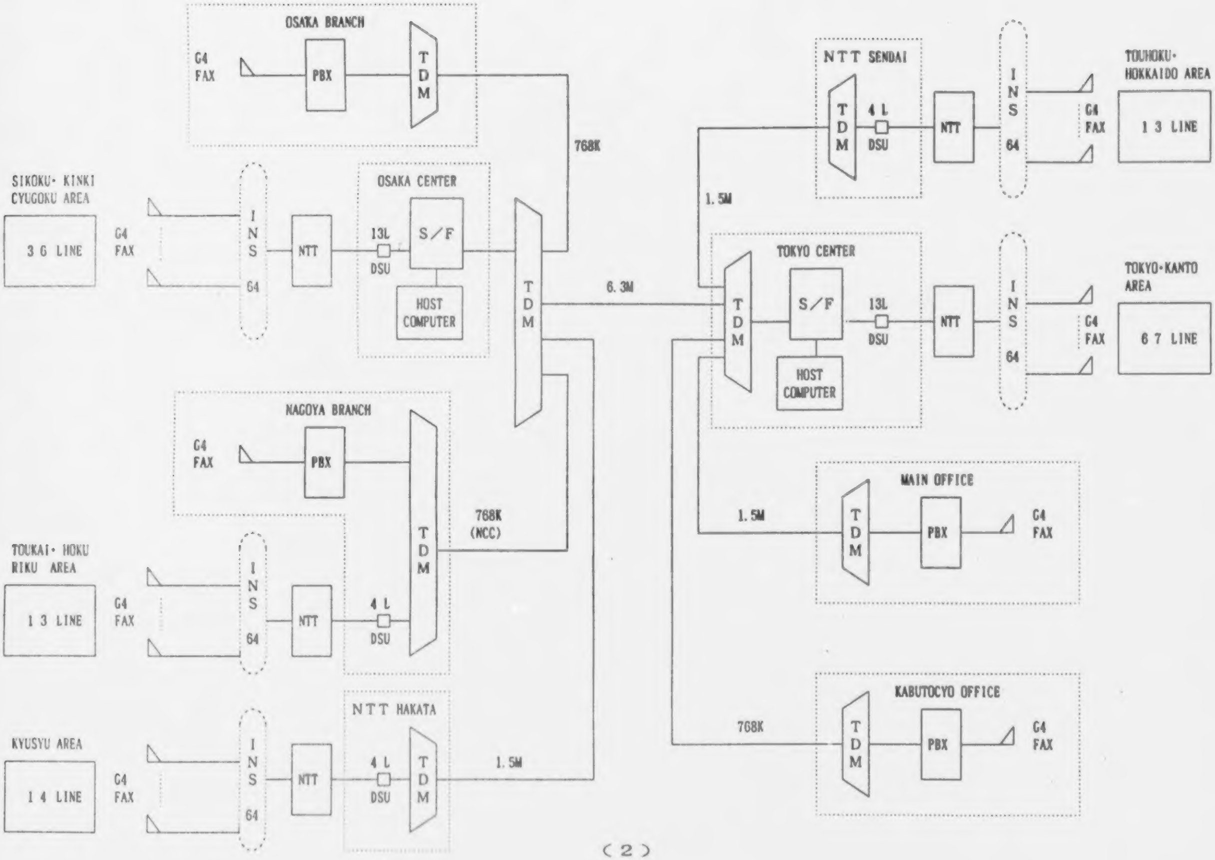
It is expected that the ISDN's users are going to grow rapidly because it provides supplementary services and has great advantage in economics and reliance:

1) cheap expenses;
2) best correspondence quality;
3) telephone, data, facsimile and other media can send over the same access line;
4) call transfer;
5) call waiting;
6) three party service;
7) direct dialing;
8) sub-addressing;
9) others

So, it is important to realize that the business world will not be able to afford a large number of communication exchange without ISDN, and a period of ISDN is coming now.


subscriber loop
(single pair copper wire)
The basic interface(2B+D)
Network termination
B channel(64Kb/s)
B channel(64Kb/s)
D channel(16Kb/s)
The primary rate interface(23 B+D or 24B/D)
(23B+D) subscriber loop
(optical fiber)
PBX
Network termination
B channel(64Kb/s)×23
D channel(64Kb/s)
(24B/D) subscriberloop
(optical fiber)
Network termination
PBX
B channel(64Kb/s)×24
N T
Using D channel
of another line

(1)


OSAKA BRANCH
G4 FAX
PBX
TDM
768K
SIKOKU・KINKI CYUGOKU AREA
3 6 LINE
G4 FAX
INS 64
NTT
OSAKA CENTER
13L
DSU
S／F
HOST COMPUTER
TDM
6.3M
NAGOYA BRANCH
G4 FAX
PBX
TDM
768K (NCC)
TOUKAI・HOKU RIKU AREA
1 3 LINE
G4 FAX
INS 64
NTT
4 L
DSU
NTT HAKATA
KYUSYU AREA
1 4 LINE
G4 FAX
INS 64
NTT
4 L
DSU
TDM
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INS 64
G4 FAX
TOUHOKU・HOKKAIDO AREA
1 3 LINE
1.5M
TOKYO CENTER
TDM
S／F
13L
DSU
NTT
HOST COMPUTER
INS 64
G4 FAX
TOKYO・KANTO AREA
6 7 LINE
MAIN OFFICE
1.5M
TDM
PBX
G4 FAX
KABUTOCYO OFFICE
768K
TDM
PBX
G4 FAX

（2）

The Challenge of Emerging Mobile Communications Technologies for the Pacific Rim

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Mobile communications in the Pacific Rim is poised to grow at the fastest rate in the world -- the region needs mobile solutions and has both the technological base and the resources to accommodate them. Service providers in the Pacific Rim must choose which of several mobile technologies, including cellular, CT2, MSS and PCN, offer the best potential for both current and short-term needs and long-term success and viability. Mobile communications information management systems will need to offer highly advanced functionality to support these technologies and their application in the region.

Mobile communications offers tremendous revenue potential around the world, particularly in the Pacific Rim. Mobile is quickly becoming not only the fastest growing segment of the telecommunications market, but also the most important one. In the future, the majority of new phone service everywhere in the world will be mobile. Here's what's happening in Pacific Rim countries:

"NTT had annual increases of 100 percent (in mobile phone subscribers) throughout the early 1980s." (*The Financial Times*)

"The number of mobile phones (in Hong Kong) has grown by some 60 percent in the past 12 months." (*Journal of Commerce*)

"Mobile communications is the fastest growing telecommunications sector in Australia. Between 1986 and 1990, the average annual growth rate was about 55 percent." (*Datapro*)

U.S. News and World Report states that today, cellular is a $3 billion business. And it continues to grow by leaps and bounds. The Pacific Rim, in particular, is poised for growth in mobile communications beyond any expert's most outlandish projections and dreams. The region needs mobile communications, and has the resources to afford and implement the technologies immediately.
Telecommunications companies and their vendors should act quickly to take full advantage of this market.

Pacific Rim Characteristics

The Pacific Rim is a study in contrasts.

Several important conditions are evident when you look at a map of the Pacific Rim. The first is the great distances involved in the region. From Bombay to Tokyo is more than 6700 kilometers or 4200 miles. From Bombay to Wellington in New Zealand is nearly 12,500 kilometers or over 7700 miles. From Tokyo to Wellington is 9,200 kilometers, more than 5700 miles.

The Pacific Rim triangle that these cities skirt encompasses over 50 million square kilometers; close to 20 million square miles. That's about one-tenth the total surface area of the earth. And the region contains a full 40 percent of the world's people.

There is great diversity within the long distances in the Pacific Rim. While the population in Japan is densely concentrated, China and Australia have vast distances between population centers and very low population density. Cellular and other mobile services must be functional in areas of widely differing population concentrations in the region.

Land types in the Pacific Rim also have great diversity. Obviously there are a large number of islands in the area. The Philippines alone is composed of well over 50 main islands, and a total of over 7000; Japan, about 40.

On the other end of the spectrum is China, which is essentially one extremely large land mass. The region contains volcanic areas, deserts, rain forests, flood plains -- nearly every type of topography found on earth. This presents unique and substantial challenges to typical wire-based telecommunications, and great opportunities for mobile communications technologies.

The region also has great contrasts in technological maturity. Hong Kong, Japan, and Singapore are competing to have the most sophisticated telecommunications infrastructure in the region. It is no coincidence that they are three of the leading economic centers in the area. In fact, it is not because these areas are world trade centers that they have built up their communications Just the opposite is true. Each country made the investment in sophisticated telecommunications technology, which directly fueled their increasing importance in world markets.

Some of the other countries in the region are just beginning their industrialization and modernization; they have virtually no communications infrastructure at all.

These geographic and technological contrasts are fueling the need for increased mobile communications services in the Pacific Rim. Several factors, in particular, make installing additional physical lines to transmit voice, data and video an unattractive option:

- The great number of islands in the region
- The vast distances between population centers in much of the area
- The expense and difficulty of installing more cable and expanding existing wireline services in major centers such as Tokyo, Hong Kong, Manila, and Osaka

Mobile telecommunications solutions are therefore critical for the continued growth of the Pacific Rim area.

The region currently has widely differing levels of cellular subscribership. Hong Kong has over 50,000 customers out of a total population of about 5 million, for a penetration rate of 1 percent. The Philippines, on the other hand, have less than 5000 cellular subscribers, with a penetration rate of less than one tenth of one percent. Other countries fall in between in numbers and penetration rates. (see figure 1)

Pacific Rim Cellular Markets

Country	# of subscribers*	Penetration
Australia	140,000	.9 %
Hong Kong	51,000	1.0 %
Japan	400,000	.4 %
New Zealand	23,000	.7 %
Philippines	2,500	.01%
Singapore	17,000	.7 %
South Korea	20,000	.05%
Taiwan	22,000	.1 %

* As of April 1, 1990 Source: *Worldbeat*

Figure 1

What is clear is that those countries which have the most sophisticated telecommunications infrastructure and which are the business and financial leaders in the Pacific Rim, are also those which have most fully embraced cellular communications.

Finally, the Pacific Rim has the necessary financial resources to invest in the most technologically advanced communications available. (see figure 2)

Pacific Rim Gross Domestic Products

Country	GDP growth*
Australia	< 2 %
China	4 - 4.5 %
Hong Kong	3 %
Indonesia	> 4 %
Japan	3 - 4 %
Malaysia	6.4 %
Philippines	4 %
Singapore	6 %
South Korea	6 %
Thailand	7.8 %

* Growth from 1988 - 1989

Source: *Business International*

Figure 2

Of all the countries in the region, only Australia has a Gross Domestic Product (GDP) growth rate of less than 3 percent. Some of the GDPs are going through the roof: South Korea and Singapore, 6 percent in 1989; Malaysia, 6.4 percent; Thailand, an unheard of 7.8 percent. These figures compare to the United States' GDP in 1989 of 1.8 percent.

The Pacific Rim's phenomenal growth has been fueled largely by its embrace of new technology; the growth will be sustained by incorporating the most sophisticated communications capabilities in the world.

Mobile communications is playing the leading role in expanding the basic scope of telecommunications. This is crucial to the continued leadership position of the Pacific Rim. While other telecom technologies mature, and new products within those technologies are few and far between, mobile's growth and its rate of new product development are stunning.

Emerging Mobile Communications Technologies

One very exciting factor that will fuel mobile's continued growth in the Pacific Rim is the emergence of new or revised technologies to challenge cellular's dominance there. CT2, second-generation cordless telephony, is competing for the low-price subscribers. Mobile Satellite Services, MSS, are on the verge of offering wide availability and technological superiority over cellular. Personal Communications Networks, PCN, could represent a convergence of the best all the services have to offer.

Service providers in Europe and the United States are positioning CT2 (second-generation cordless telephony) technology as an efficient way to bring mobile communications' benefits to the mass consumer market. This should follow shortly in the Pacific Rim as well.

CT2's charter is to provide advanced cordless telephone service combined with remote access to the public switched telephone network. The service operates using micro-cell areas with diameters of a few hundred yards, and is geared toward use in high population-density areas, such as shopping malls and airports.

CT2 is by definition a one-way calling service. Users may make only outgoing calls on the handsets. This attribute is at the crux of the debate about the future viability of the technology. Detractors claim that not only is one-way calling too restrictive, the service also will not be viewed as "high-tech" and attractive to targeted markets. Supporters claim that one-way calling is desired by a substantial portion of the market -- those who don't want to be reachable 24 hours a day. In addition, proponents claim, incorporating a pager into the CT2 handset would allow virtual two-way communications.

CT2 is a very good way of augmenting the existing public telephone networks in the Pacific Rim, or creating new public networks where one does not yet exist. Start-up costs, space requirements, and environmental concerns are all minimal.

Mobile Satellite Services (MSS) providers are at the beginning of a long and expensive road of investment for the future. MSS is designed to reach a variety of widespread potential users via transmissions from satellites in geostationary equatorial orbit. The satellites broadcast over a very large area of land and/or water. In addition to voice communications, potential MSS uses include aeronautical communications, vehicle tracking and nationwide trucking data networks.

In Europe and the United States, one of the major issues facing the viability of MSS is the cost of the service versus land-based mobile communications like cellular. While large land masses such as Europe, or Australia and China, can be covered with land-based systems, the Pacific Rim as a whole needs new solutions to fuel the growth of the entire region.

MSS certainly can be one part of those new solutions. The Iridium system by Motorola will allow mobile phone service from anywhere to anywhere in the world as early as 1996. As few as one or two satellites could provide mobile communications anywhere within the Pacific Rim. This "pan-Pacific Rim" capability is essential to the continued growth and world leadership of the region.

Personal Communications Networks, in their most advanced forms, will offer the best of all mobile technologies. In fact, PCN may very well use a combination of all the above-described technologies to achieve person-to-person communications. Currently, communications take place from station-to-station. With PCN, even with current GSM standards, the potential is there for telephone numbers to be associated with people, not locations.

In the not-too-distant future, a subscriber in New Delhi will pick up her PCN handset and dial the number of a business partner in Sydney. The signal from her handset will be transmitted via a series of microcells, through a traditional cellular switching tower, be uplinked to a satellite traveling thousands of kilometers above the earth, downlinked to a terrestrial microwave station, again travel through cells and microcells, and find the business partner's PCN handset in Melbourne, because he is gone from Sydney for the day.

This transaction will soon be possible with the realization and maturing of the PCN concept. Whether or not the full potential of PCN is ever utilized will depend upon the ability of the various service providers and government agencies to work out the extremely complicated agreements necessary for it to happen.

In my vision, I think the day will come sooner than later. If not in the Pacific Rim, then in some other area anxious to establish itself as the business and financial leader of the world. Perhaps North Africa and the Mediterranean. Or maybe even North America, where Mexico is just now beginning to upgrade its business infrastructure.

Strategic Information Management Needs

Seamless mobile communications throughout the Pacific Rim will have to be supported by an enormous infrastructure of goods and services. In addition to the hardware necessary, including handsets and antennas and base stations and microwave dishes and towers and satellites, the information management needs will be extremely complex. Also, the sheer volume of information that will have to be managed is staggering.

A market penetration rate of only 2 percent would mean 40 million mobile subscribers in the Pacific Rim alone. 100 million worldwide. This sounds like a large number; an unattainable number. It can be put into some perspective by examining the penetration rate in the United States. In just over seven years of service, cellular communications alone has already reached a penetration rate of about 2 percent.

As the mobile communications industry matures in the Pacific Rim, information management systems will be asked to provide much more support than merely keeping track of names and addresses and identification numbers. Highly sophisticated information management will also be absolutely essential to any type of mobile communications system that: a) uses more than one technology at a time, b) provides service over great distances, or c) provides service to a large number of subscribers.

In the expansion stage of mobile communications, information systems will be expected to manage three important areas:
1. Growth
2. Expanded bases of operations
3. Increased competition

1. Growth Management

In the management of growth, mobile support systems must do three crucial jobs. They should accommodate shorter learning curves, change readily and easily, and integrate easily to encompass all aspects of a business's operations.

Applications must be user-friendly to provide faster learning as business offices expand to meet demand. The more complex and high volume the data environment, the more easily understood and used the information systems must be. As the number of mobile subscribers in the Pacific Rim begins to grow rapidly, the response times for changes to information or system parameters must become shorter. If the information cannot be kept up to date, it will effectively gridlock the entire communications system.

Finally, management systems must be integrated to offer the most functionality with the most ease of use. Common information must be able to be shared across an entire organization. Once a potential subscriber has been entered into the system (for example, for a direct marketing effort), that person's information is accessible through the entire life of his or her association with the service provider. No single piece of information should ever have to be entered into the system more than once. And users should not have to search through several systems to access the information they need.

Data exchange between departments is only one aspect of integration, however. What will provide the crucial edge for mobile service providers in the Pacific region will be the ability to focus strategic information to fulfill a mission, whether that means solving an accounting problem, targeting a market segment, or forecasting future trends. A totally integrated system encompasses all components of a company's operations. Improving the operational efficiency of management systems is an absolute necessity for the continued expansion of mobile communications services.

2. Expanded Operations Management

Decentralized environments are the most efficient way to manage rapidly expanding operations. As the mobile service areas grow, it becomes more difficult to operate disparate sites as one integrated system. However, to realize true economies of scale, the expanded bases must be able to share and transfer information transparently between sites and operational entities. While this is true all over the world, the distances between major population centers in the Pacific Rim make this functionality especially crucial.

3. Increased Competition Management

Competition will increase as cellular service in particular, and mobile communications in general, is perceived as a commodity. In a commodity environment, marketing and customer service are crucial, because they help differentiate the service and define specific customer segments to target. It will be more important than ever to determine who the customer is and what he or she needs. Information systems thus must have the ability to perform sophisticated demographic analyses.

In a commodity environment, every possible exploration for product differentiation must be explored. One of the first and most important areas is customer service. Information management systems can support customer service by providing comprehensive customer and account information in a readily available format.

Thirdly, a commodity market demands that every marketing plan yield the greatest possible results. Information systems that allow "what if?" analysis and provide in-depth projections based on actual system data provide an important competitive marketing tool.

Daily Information Management Operational Needs

In addition to large strategic missions, information management systems must be able to perform all the day-to-day operations that comprise the backbone of providing mobile service. At CBIS, we've strived to provide these services in complete packages, and have been rewarded by becoming the market leader in mobile communications information management services in North America. The Pacific Rim needs these services as well to fuel the expansion of mobile communications in the region:

- Accounts management

Accurate and up-to-date account information is necessary for a mobile service provider to be able to control cash flow and market new and enhanced services to existing subscribers.

- Credit and collecting

Managing credit information on current and potential subscribers is essential in controlling losses and limiting exposure to uncollectable charges.

- Fraud detection

With the complications in providing mobile communications services in the region, fraud detection and prevention will be of major importance in protecting revenue income and profit margins.

- Inventory management

Inventory management is the ability to keep accurate records on all equipment, particularly leased or rented equipment, and provides the ability to bill back equipment costs to users.

- Message processing and rating

One of the most basic needs in any mobile service offering, accurate message processing and rating ensures that all communications are recorded fairly and accurately.

- Bill preparation and inquiry

A bill preparation and inquiry system should provide the capability to gather all information necessary to print a bill; the flexibility to stagger the billing cycle to achieve better cash flow; and on-line access to a subscriber's usage and payment history.

- Roaming processing and positive validation

The Pacific Rim region, comprising more than a dozen countries in total, will need extremely sophisticated roaming processing and positive validation to ensure correct account record keeping and smooth operations for subscribers as they move throughout the entire Pacific Rim.

- Switch management

A switch management function handles subscriber activations, cancellations, and switch features. It also manages transmitting message information from the mobile switch to the information management system for account management and billing purposes.

The extremely rapid rate of change and expansion in mobile communications makes it necessary for information management systems to be based on both current and future needs of the industry. Systems which are not adaptable will become obsolete in a matter of years (if not months), as new technologies and increasing subscriber numbers will present ever-increasing demands on the support infrastructure.

The countries of the Pacific Rim region are looking for increasingly sophisticated communications technologies. These will enable them to retain their positions as economic and technological world leaders, and must be planned for now for both the immediate and distant future. The geographical, technological, and economic factors in the region call for a combination of mobile technologies to build and expand the area's telecommunications network.

Companies must plan now for technological superiority and adaptability in their communications products and information management support systems. This will position them to capitalize on the myriad opportunities the mobile communications revolution affords as it comes to the region in full force.

Advanced International Private Networks

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1. Abstract

Many enterprises adopt their international private networks as strategic networks to cope with a total restructuring of world industry and business. Each network is necessarily flexible against both the innovation of technologies and the reform of telecommunications regulations. This paper is a preliminary attempt to explore the effective network exploitation.

2. Introduction

Although there are a great many coffee shops in Tokyo, they are not only to have a cup of coffee and a chat. In a coffee shop an owner tries to provide distingushed services and makes a guest feel comfortable. As a result he or she makes a profit. One example is the shop where conversation is basically prohibited and a smooth classic music is never ceased. In the quiet shop there are not a few people who read a book or a magazine and several people who write a report. One of the lowest coffee is served at the another chain stores tied up with a transportor which reduces delivery cost of materials. A cup of coffee costs 150 yen which is a third of an average price. Though there is no chairs, a lot of business persons take a rest there. Another example is existed where no one can enter without an entrance key because it is opened for members. A gorgeous cup that costs over 400 dollars is settled for a member. Where would you like to have a cup of coffee? It may depend on time, place and opportunity. Preference for not only a coffee shop but also many goods and services, what we call needs, is the most crucial point discussed in Japanese business market. May we accumulate informations to grasp needs by implementing and managing an advanced network? If we can, what kind of mechanism does the network exploitation have?

3. Information Networks of Japanese Enterprises

3.1 International

Demand for international telecommunications in Japan is drastically increasing. This is partly because of the reduction of telecommunications charge and partly because of the expansion to abroad of Japanese enterprises. The fundamental triggers are the big change of the dollar-yen rate and the introduction of competition into the telecommunications market.

Two new companies entered international telecommunications in the second quarter of 1989 to supplement KDD, which had been the sole international carrier until that time. In case of international calls, there is not a big difference of competitive conditions among carriers, which are a prefix, contracts etc. The charge of international leased circuits is also extremely reduced. Ten years ago a few enterprises used them, however, a lot of enterprises do so now. For example it costed over 5 million yen per month to lease a voice grade circuit(9.6kb/s) between London and Tokyo. We can lease a 50 times capacity at the almost same cost. More than 1,000 enterprises use high speed digital circuits (over 64kb/s) in Japan, therefore it is becoming popular of leasing a large capacity of international leased circuit.

As a result, not a few enterprises connect key points in a wide area. An enterprise in transportation has operated a wide network of connecting seven points in the world with large capacity leased circuits and extended with voice grade circuits from each key points (Fig. 1). They operate their network as an integrated network of telex , telephone and several types of data communications. An enterprise in finance has double-triangle network connected among North America, Europe, and Japan (Fig. 2). It is becoming common for users of large capacity leased circuits to prepare back-up circuits. The reliability of a network is even so important, it is unusual to operate the double-triangle network. It can be said that the double-triangle is one of ways toward an advanced networking.

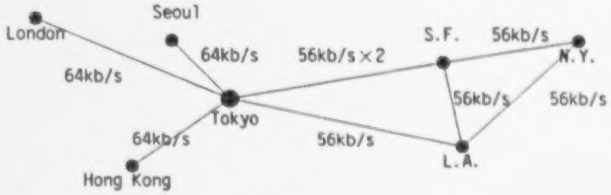

Figure.1 Network Overview ①

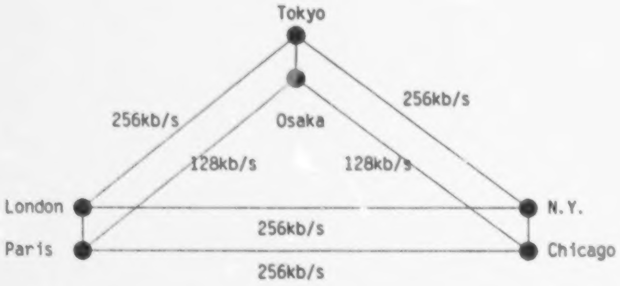

Figure.2 Network Overview ②

3.2 Domestic

As with the Japanese domestic situation, it is one of the hottest issues to struggle for finding an appropriate network management system, because users operate more dense and complex networks. Most of the private networks are never ceased through out the year, even on the first of January, which is the restful day in Japan. When a trouble ocurres in a network, the allowed time for users to stop and investigate its operation is the maximam of 1 hour according to our survey. In addition network elements such as private branch exchanges, time division multiplexers, packet exchanges, etc. are becoming more varied and sofisticated. The shortage of skilled maintenance technicians is also becoming a serious problem. Maintenance of a network was mainly engaged by carriers and/or vendors in the past, however, it is becoming difficult without a person who is well informed its organization to treat troubles in a network.

3.3 Usage of Enhanced services

After the introduction of competition into telecommunications in 1985, there appeared Type Ⅱ carriers which have offered enhanced services in Japan, including a network management of systems. There are 29 special Type Ⅱ carrier resistered, 873 general Type Ⅱ carriers notified to Ministry of Posts and Telecommunications until November 1990.[1]

I classify three groups for special Type Ⅱ carriers in terms of the line of business, as vendor line, data processing line and communications line respectively (Fig. 3).

In case of data processing line, operating a network is to offer more advanced data processing services and to develop various software applications. The average scale of their sales is approximately three to four thousand million dollars. In general their major part of sales is consisted of software development and data processing services. The proportion of communications services in sale is rather small.

Most of businesses in communications line are new comers after the reform of Telecommunications Business Law. They seldom have shares on data processing, software development and hardware sale. Their average scale of sale seems to be the smallest among three groups. Particularly businesses which entered into international VAN market have not publisized their total sales. Because most of them seems to be still in red ink, they try to step out the first stage to make their business bigger.

Four major vendors had entered into the telecommunications market soon after the reform of TBL, the rest of them also entered since 1988. The characteristics of vendor line group are that a network is a utility to support its main business to sell hardware equipments. From the view point of the long-term management they have invested into telecommunications businesses. However it is hard to pick up the gross of its Type Ⅱ telecommunications business from its own total sale on the average over 7.5 billion dollars. I estimated that one of the biggest was less than a tenth of the total sale, including about fourty million dollars of communications services sale. They seem to continue investing communications services, which do not contribute so much to the total sale, therefore communications services will be expected to play a major role in the future business.

From the questionnairing survey conducted in November 1989 by IFTECH, usage of two services is shown Figure 4. One is data processing services as electric ordering, data-base services, inventory management, etc. The other is communications services as reselling leased circuits, private extension calls, circuits switching, etc. The questionnaires were delivered to 500 users of two services and 206 samples were collected, then the final rate was about 41%.

Electric ordering was the service that the most enterprises used, which was the most familiar with a word of " VAN " in Japan. Electric ordering is that service providers collect and process some of informations, sold records, order records, etc. from many retail stores and rearrange or analyze them to member entities. The informations is one of key factors to decide its strategy. There exists the strong driving force to enclose individual business within a network through distribution lines. The types of a network organization are a horizontal linkage within an industry or regional businesses and a vertical linkage through distribution lines such as a whole saler

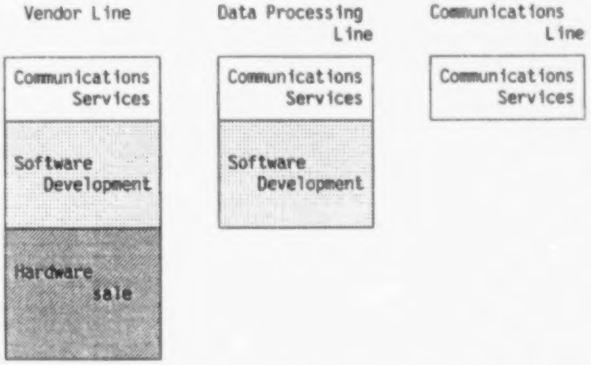

Figure.3 Structure for Line of Business in Special Type Ⅱ Carriers

leading, a retail saler leading, a manufacturer leading, etc.

The next popular service was reselling leased circuits. It makes an advantage of a large amount reduction of Type I carriers. Type II carriers lease a large capacity, then resell to end users by a small capacity like 9.6 kb/s or a voice grade at reduced costs.

It was also found that usage of these services are higher, private extension calls 27.6%, circuits swiching 26.3%, packet switching 23.7%, and enhanced facsimile mail 23.0%, which are all in communications services. Data base services are the second highest usage 22.4% in data processing services.

In terms of the industry the result is shown in Figure 5. It is clear that there are some differences among the industries. In the retail industry, the usage of the data processing services is higher than that of communications services. On the contrary in the processing industry and manufacturing industry the results are clearly contractive.

In general enhanced service providers in Japan have burdens of telecommunications facilities in their budget. Still most of them are not good at in business. But users appreciate that the services are various, customer oriented, and cost effective in comparison with those of carriers. What is more significant to many enterprise network planners and users is that various kinds of service rate schedules have become available. Some of them are beneficial for low traffic users which some others allow high traffic users to use the service as if they wereusing a leased circuit, but at reduced costs.

About half of enterprises answering questionnaires had paid more than 77 thousand dollars to Type II carriers except for the initial costs. The three fourths of them expected that the amount of payment would increase in these five years.

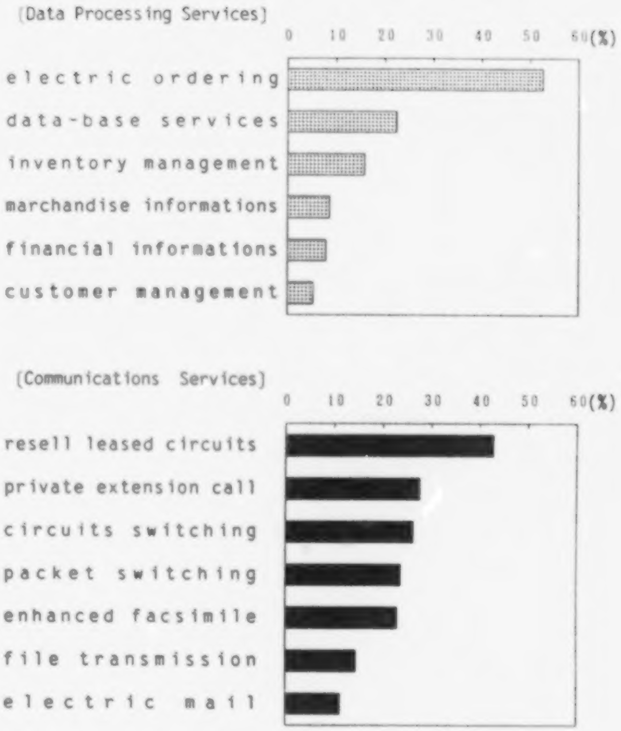

Figure.4 User's usage for Services of Type II Carriers

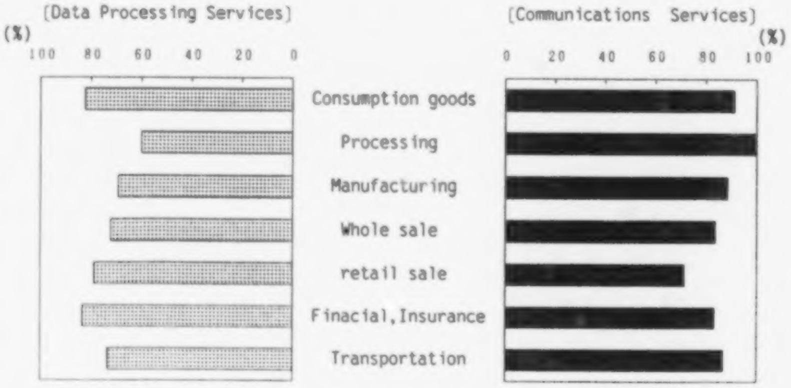

Figure.5 Percentage of two services for each industry

Public and private networks are becoming hybridized. The movement to integrate ISDN in a private network is growing now, which used to back up leased circuits and use by G4 facsimile in Japan. Some of banks introduce ISDN to watch Automatic Teller Machines from control centers. According to statistic, the number of ISDN reached to 14,654 until the end of October 1990, however, it had been 4600 at the end of 1989. Because the scale of ISDN becomes wider, usage of ISDN is rapidly becoming popular. Percentage of ISDN for industries at that time is shown Figure 6. Finance was the top user of ISDN. It is important for an enterprise to integrate public networks with a private network as the improvement of public networks, which is also one of ways toward an advanced network.

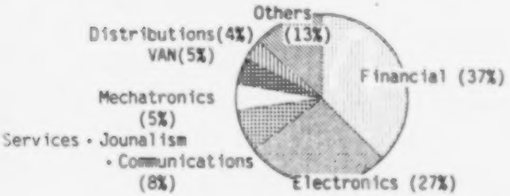

Figure.6 Percentage of ISDN service for industries (Dec. 1989)

4. Effective Network Exploitation

The emergence of competitive environments in internatinal telecommunications are creating new requirements of users. Even now enterprises mostly seek to reduce their telecommunications costs. In addition they require their networks to help to organize and improve their production processes and better to grasp demand fluctuations. When a new branch office is planned owing to reorganization, a network is required to respond quickly and to help. When new goods are appeared in public, a network is required to grasp reactions of users accurately. A network is to carry out partly a function of a planning department, therefore it can be called a "strategic" network. It is becoming clear that a character of a network is directly related to the quality of informations. They require high-quality information from their worldwide information networks to ensure contacts with the business sector, but also with governments and other institutions to collect information on economic, social and political environments. Enterprises such as insurance and securities companies, banks, trading companies, etc. have a number of branches and customers located in major cities in North America, Europe, and Asia. The big manufactures have also connected their factories abroad to make more rapid response to market changes, greater production flexibility, and speedier and better work processes. The transition of these systems is listed table 1. Their subcontractors and affiliated companies expanded abroad together.

The requirements of users to their networks are putted in order as the following:

- Reliability
- Reduction of telecommunications costs
- Easiness to manage
- Easiness to access
- Chance to encouter

These requirements - reliability, reduced costs, easiness to manage, easiness to access, and chance to encounter something valuable- are shared by most enterprises in most industrialized countries. Cross-national differences however reside in the details of precisely how they use similar telecommunications technologies to pursue their requirements.

According to Prof.Imai and other's method[2] , they identify three types of international networks: traditional multi-domestic, global, and cross-border networks. They underlined cross-border networks which simultaneously attempted a quasi-autonomous management in each region along with an interpenetrated global coordination in key variables. Gaining intimate knowledge of local markets and regulations and making real-time strategic adjustments globally were key factors in the regime of continuous interractive innovation.

They emphasized the function of chances to encouter through a network, in other words, the

Table.1 Transition of Systems

Conventional	Present
• Line-oriented	• Task-oriented
• common system mass production	• individual system flexible manufacturing system characteristic ordering system
• central processing	• equilibrium of central processing and distributed processing
• resolved system to treat problems (e.g. costs reduction) at the time	• combination of systems to find the way toward its goal in the future

function of gaining "on the spot informations". I understand that the requirement of chance to encounter is the most advanced one. In case of the activities of the Japanese Sogo Shosha, when they need some informations they should be there. Their networks are wide all over the world, which are not always used advanced technology but organized with skillful persons. There must be a wide gap between the requirement of chance to encounter and others.

The primary objectives of enterprises users vary in each case. When requiring telecom is a reliability, firms can lease double-triangle networks as mentioned before. As a force to reduce telecommunications costs, they can lease a large-capacity circuits, connect key points in the world. As pursuing easiness to manage, they may build a simple network as possible as they can. But it cannot be enough flexible against changes of environments, when a network is required to grasp demand fluctuations and to bundle services with their products to capture customers. As pursuing easiness to access, they must be able to apply the technologies where and when they are needed, and to make changes in existing network arrangements as activities or strategies change. It will be expensive to develop the available applications and the several alternatives by their own.

There are a lot of contradictions among the requirements above. Therefore they must also be able to engage in the long-term process of experimentation and cumulative learning that supports progress in the effective combination of network requirements. They must store some know-how from a process of trial and error. This is the main routine of the effective network exploitation.

It is thus important for enterprises users to have various kinds of alternatives in telecommunications structure. As mentioned chapter 3, many telecommunications services are now provided in Japan owing to many participants in telecommunications businesses. Enterprises have access to a reasonable choice of network alternatives, from integrated public-switched services and Type II telecommunications businesses to private facilities and dedicated applications. For small and medium-sized enterprises especially, VAN suppliers and an integrated public network provider can play a significant role in making appropriate technology available in a timely fashion. If choice is too limited, the less possibility for undergoing a process of trial and error.

In Japanese domestic situation, it is clear that many participants into telecommunications businesses provide their services to end users and also use them for their own businesses. Most of them seldom make a profit from the telecom sections, however, they have accumulated a lot of know-how about the telecommunications. And some of them have stimulated each other to use an advanced network. It is expected that the international telecommunications environment is becoming the same way.

Telecommunications services are usually regulated in most countries. Then deregulations make a big influence on the telecommunications environment.

For example, U.S.-Japan telecommunications talks of July 1990 brought to deregulate the condions of a leased circuit between them. Especially in terms of intracorporate communications, the interconnection private leased circuits to the public switched telephone network is conditionally permitted. In Japan domestic condition, it is still inhibited. The reform like this effects the telecommunications` environments. Enterprises have broader access, which they can call both a colleague in New York and in Tokyo at almost same cost. It will create a new diverse relation. They can conceive of radically innovative ways of integrating communications and business activities.

These flexibilities of network resources from the various alternatives and the reform of telecommunications regulation will allow an enterprise to experiment with telecommunications adaptations, learn from the experimentation, and repeatedly restructure itself. The better enterprise never ends this cycle.

Footnote:

(1) Of the companies that are in the telecommunications business, those in posession of their own facilities are called Type I telecommunications carriers. Those engaged in advanced services using facilities leased from the Type I carriers are called Type II carriers. Among the latter are special enterprises that provide large-scale/wide-area services or international services to unspecified users, along with general enterprises that furnish services other than these.

(2) Systemic Innovation and Cross-Border Networks by Ken-ichi Imai and Yasunori Baba, which prepared for international Seminar on the Contributions of Science and Technology to Economic Growth at the Organization for Economic Cooperation and Development, Paris, June 1989.

BROADBAND PUBLIC COMMUNICATIONS - THE DRIVERS

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1. Abstract

Advances in data communications and terminal technologies, and in the nature of software applications and man-machine interfaces, have fundamentally changed the business environment and the requirements of data transport. The very rapid growth of Local Area Networks has created a near-term need for new public switched broadband services to more effectively extend a high speed communications infrastructure beyond the customer premises. This paper will discuss the technology and market drivers of these public broadband data communications services, and will identify the early customer networking applications which are likely to motivate the deployment of a public broadband network infrastructure.

2. Introduction

The tremendous market success of desktop and workgroup processors during the past decade has intensified the need for high speed intra-premises connectivity, initially to realize the economic advantages of shared devices and to support electronic communications in the local workgroup, and, subsequently, to access critical distributed information and to share software applications. Within the customer premises environment, these needs were met with the very successful introduction of high speed Local Area Networking (LAN) products. Recent improvements in presentation hardware, the introduction of graphical user interfaces, and the growing use of image to represent processed information have fueled the need for even higher speed data communications infrastructures. The emergence of Fiber Distributed Data Interface (FDDI) standards and early products is one clear response to these market pressures. The use of Wide Area Networks to link geographically separated private network locations, however, has often failed to meet the performance expectations of users in conjunction with these emerging bandwidth intensive applications.

As a result of these market trends and a series of network technology advances, a very real near-term opportunity has emerged for broadband public switched services. These services may more efficiently interconnect the islands of broadband data communications functionality on the customer's premises. Further, the availability of a public switched broadband infrastructure supporting casual communications sessions which extend beyond the boundaries of building, corporation, or nation could spur a new generation of user applications with the potential to change the way business is conducted.

This paper will address these market and technology drivers, and will examine those customer applications which are most likely to justify deployment of a public broadband network infrastructure. We will also address promising follow-on applications which are particularly well suited to high speed public switched transport solutions, and will consider the role of these early broadband communications services in an evolution to BISDN.

The NYNEX Corporation and other regional telephone companies in the United States plan to introduce, in the early 1990s, a very high speed public switched packet data communications service, Switched Multi-megabit Data Service, which is targeted to these emerging customer needs. We expect this shared Metropolitan Area Network (MAN) service to be but the first of a series of new public switched broadband services available to customers. This paper will identify some of the critical factors which will impact the success of these early broadband public network services.

3. The Evolution of the Premises Environment

During the first half of the 1980s, high speed Local Area Network (LAN) systems were most often implemented in order to realize the economic benefit of sharing costly peripheral devices among the universe of users and to provide local workgroup electronic communications. More recently, however, tremendous advances have been made in the power, cost, and speed of the underlying technologies, particularly micro-processor chips and data storage devices, which have changed the way business is conducted. These changes have resulted in a second, more strategic justification of high speed premises communications systems. As the power of the consolidated computer center has migrated toward the desktop of the individual knowledge worker, critical business information has become more distributed throughout the customer premises environment. These technology and product advances have powered a transition from the Age of Automation of the early 1980s, to the Age of Information. And the pace of this distribution of business intelligence is accelerating rapidly.

The migration of computational power and stored data from the computer center, toward the desktop, has created a need to manage and retrieve distributed business intelligence. Accessing strategically important distributed information in a timely, accurate fashion poses major challenges to businesses to construct effective data communications infrastructures, to manage and coordinate data, and to integrate discrete, distributed processing and communications elements into a strategic corporate information network. The need of customers to access, manage and integrate their strategic information and communications resources has accelerated the growth in expenditures for high speed intra-premises communications products in the latter 1980s.

Local Area Network (LAN) revenues in the U.S. market totaled about $125 million during 1983, and increased to almost $1 billion in 1986. In 1987 sales mushroomed by 68% over 1986 levels to approximately $1.6 billion (1). Strong double-digit growth has continued in a maturing U.S. market, where LAN revenues have been forecasted to reach $4.0 billion by year-end 1990, and $11.1 billion in 1995 (2). The international LAN market also began to pick up considerable momentum late in the decade. In Europe, 1989 LAN revenues rose to an all time high of almost $1.5 billion (3). By 1994, this market is expected to reach $5.3 billion (4). Worldwide, the total number of LAN connections shipped during 1988 increased by 81.7% over 1987 to a year-end total of 3.5 million nodes (5).

While strong growth is expected to continue as the LAN market reaches maturity, entirely new data networking opportunities are now emerging. Businesses have moved beyond departmental level networks, and are implementing products to interconnect LANS within and between corporate locations. The market for communications devices such as bridges, routers, gateways and proprietary backbone LANs to link isolated network islands has exploded. As the forecasted volumes of traffic between discrete LANs increased, the need for new standardized products providing very high speed data transport more cost effectively became apparent.

4. The Impact of FDDI

The emerging Fiber Distributed Data Interface (FDDI) is the proposed technical standard for a fiber optic-based private network data communications facility operating at 100 Mb/s. The specification, developed by the American National Standard Institute (ANSI) Committee X3T9, defines the first two layers of the Open Systems Interconnection (OSI) Reference Model. As the standard nears completion, there has been a spate of recent FDDI product announcements from established data communications vendors. Most of these announcements target specialized end-user environments and backbone networking applications.

FDDI is forecasted to grow at triple digit rates through the mid-1990s, as the installed base of products increases from approximately 2100 units in 1990, to 683,000 units in 1995. End-user FDDI systems, primarily for specialized technical workstations environments, are predicted to dominate early unit sales, growing to almost 85% of the units in service by 1995. Revenues, however, are expected to be driven by backbone applications which, though small in total numbers, are likely to command sizeable price premiums. Backbone applications are forecast to range from 65-70% of total revenues annually between 1992 and 1994. While considerable market success is expected for FDDI products, they will continue to represent only a small fraction of the total LAN market through the mid-1990s (6).

The longer term success of FDDI may be at least partly dependent upon user applications which do not currently exist in the business market and which will be enabled by commercially available distributed processing software. Multi-media sessions involving image, video, voice and distributed data storage and manipulation are particularly promising drivers of future intra-premises broadband transport products. But with the success of intra-premises applications, the need to extend high speed networking beyond the customer premises will increase.

5. Public Network Support of Wide Area Networks

Large business users have increasingly turned to high speed private line facilities leased from public network service providers, and others, to construct Wide Area Networks (WANs) to meet their combined voice and data transport requirements. For the largest business users, high speed private lines used to aggregate point-to-point traffic have proven to be an economically attractive alternative to currently available narrowband public switched services. Channelized and non-channelized DS-1 (1.5 Mb/s) facilities have become essential elements of customer private network solutions, and have seen tremendous growth during the 1980s.

Growth of DS-1 circuits in the U.S. is expected to slow to approximately 15% per year for the next five years. The declining rate of growth of DS-1 circuits is caused in part by the recent use of highly intelligent multiplexers, and by the emerging market availability of even larger bandwidth facilities. The compound annual growth of DS-3 (45 Mb/s) circuits is expected to exceed 40% per year through 1995 (7).

The regional telephone companies in the United States have constructed advanced channel-switched service infrastructures to meet the needs of these large bandwidth intensive customers. Elements of this network include high bandwidth loops, digital cross-connect devices, high speed multiplexers, broadband interoffice facilities, and a sophisticated management and administration system. Often, in the larger metropolitan markets, optical transmission systems based upon vendor proprietary products have proven to be the most economical means to provide these high bandwidth private network services.

Explosive growth and customer demand for service reconfiguration and protection capabilities have encouraged fierce competition among public and private network service providers in major U.S. cities. Efforts to differentiate services in order to effectively compete in this marketplace have encouraged a plethora of service options and new technical capabilities. These include fractional T-1 services, network aggregation of underlying wideband services, drastically reduced provisioning and rearrangement intervals, and aggressive pricing.

The rapid growth of wideband networking has not been limited to the United States, however. Worldwide, growth in T-1 multiplexer unit sales is expected to continue at double digit rates, with essentially all of that growth being satisfied by intelligent networked, rather than point-to-point, multiplexers (8).

The traffic characteristics of private wideband networks have also changed during the 1980s. Historically, DS-1 facilities were typically dedicated to either voice or data applications. This is no longer the case. Today more than 50% of private DS-1 facility bandwidth carries integrated voice, data and image traffic. This percentage is expected to grow to about 70% by 1993 (9).

However, while products to support the networking of LANs within the premises and campus environments have kept pace with user data communications expectations, this has often not been true of WAN products extending transport beyond the campus scenario. Currently available wide area service offerings such as digital data private lines and narrowband public switched services operating at speeds up to 64 kb/s, and DS-1 private lines at speeds of 1.5 Mb/s, impose unacceptable communication delays on some users accustomed to the performance of high speed intra-premises networks. It is often impossible to provide data communications performance between customer locations which is comparable to that within the premises or campus.

One alternative to compensate for the substantially lower-than-LAN speed of inter-premises transport is to use much higher speed (and much higher priced) DS-3 transport facilities. But few customers find this to be an economically viable option. Other emerging alternatives which may improve the performance of high speed inter-premises data networks include the use of SONET transmission rates, Frame Relaying products, and Fast Packet technologies.

From a network service provider's perspective, we believe that advances in the underlying fiber optic technologies will continue to drive down the cost of bandwidth while increasing system capacities. The expected near term availability of SONET transmission products will facilitate even more timely, efficient provisioning of high bandwidth transport, both in the local loop and the interoffice plant. These products will also enable the provision of even higher bandwidth services.

In the longer term, with the standardization of protocols defining the use of the embedded operations capabilities, SONET may facilitate direct optical interface to customers, much more functional user control of services, and reduced telephone company dependence on vendor proprietary products. Work in the IEEE P1396 Architectural Task Group to specify a standard SONET backplane bus architecture may also speed development of innovative service interfaces for emerging products (10).

6. Broadband Public Switched Services

Recognizing the economic advantages made possible by sharing the resources of the public network, local exchange carriers in the United States have sought to develop effective public switched alternatives to private WANs. These efforts have focused on identified user needs for broadband data transport, and on the development of a public Metropolitan Area Network capability to support virtual private network services. The development of products based upon emerging national and international standards for Metropolitan Area Networks holds great promise to meet these user needs. MANs are expected to provide performance improvements over existing WAN solutions and to offer a more cost effective transport architecture for many users.

NYNEX, the other regional telephone companies, and Bellcore have been among the active participants in the rapid development of the Distributed Queue Dual Bus (DQDB) specification by the IEEE 802.6 standards committee in the United States. This Metropolitan Area Network standard is in the final stages of completion, and appears to be an excellent platform for the near-term provision of broadband public packet switched data transport services. The DQDB specification alone, however, is insufficient to support the addressing, operations, and access service requirements of a public switched service. Therefore, Bellcore was requested by the seven regional telephone companies to develop uniform multi-regional specifications for a very high speed connectionless packet switched data service which would build upon the DQDB subscriber-to-network interface defined by IEEE 802.6 (11).

This initial broadband public network service, known as Switched Multi-megabit Data Service (SMDS), will be provided on both DS-1 and DS-3 facilities. The addressing protocol in SMDS will be compatible with the E.164 ISDN Numbering standard. Additional group addressing features will support the multicast and broadcast capabilities required by the marketplace. Most of the service attributes associated with SMDS have been insulated from the underlying framing and physical interface layers so that the service can evolve to higher speeds, such as the SONET OC-3 rate, with minimal impact upon the customer's data communications environment. This approach may also facilitate a more transparent migration of the SMDS service to a BISDN network using Asynchronous Transfer Mode (ATM) switching techniques.

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7. Potential SMDS Markets

NYNEX has conducted preliminary primary and secondary market research focusing on existing and emerging business applications which would be enhanced by high speed packet switched public data services. We believe that the applications enabled by FDDI on the customer premises will stimulate demand for effective inter-premises transport. This research indicates that SMDS is likely to grow quickly following initial deployment in 1991. By the mid-1990s, the NYNEX market for high speed packet services may exceed 12,000 access connections and represent several hundreds of millions of dollars in potential annual revenues.

The predominant early application of this public MAN service is expected to be LAN-to-LAN interconnection of geographically separated customer locations. This implies that the networking application will be perceived as a virtual extension of the intra-company data communications network. SMDS will fill a critical inter-premises transport void not met by FDDI, and will complement the applications enabled by FDDI.

The greatest promise of public broadband switched services such as SMDS may be in their support of casual multi-media communications between users. Using a public switched communications network, specialized applications such as multiple media sessions between medical specialists, hospitals, laboratories and training universities could fundamentally alter basic business processes and interactions to enable significant improvements in productivity. Similar examples can be hypothesized in such diverse vertical markets as advertising, publishing, realty, tourism, and education. While the growth potential of these applications could far exceed that of simple LAN-to-LAN interconnect, their success may require fundamental changes in the way people conduct business.

Future business communications will increasingly require the use of multiple simultaneous media sessions. The coordination and control of these multi-media sessions will involve the management of voice, multi-media files, processed data in the form of text and image, and video. The capabilities of a broadband public switched network will offer opportunities for the provision of these and a myriad of other service features to enable customers to more readily manage an ever more complex communications environment.

The market success of effective broadband public switched services is a prerequisite to the future infrastructure modernizations contemplated by BISDN. Considerable technical and marketing effort must focus on potential customer applications of emerging technologies to identify the most promising business opportunities for their implementation. With the market success of discrete broadband switched services and applications, BISDN will provide a more functional and economical infrastructure for their delivery.

The NYNEX Science & Technology Laboratories have established strategic partnering relationships with key customers, switch vendors, and suppliers of customer hardware and software products in order to develop a clear, common understanding of the technical and marketing issues impacting the introduction of this new class of communications services. We are working with potential end users to jointly develop specialized applications in the fields of medical imaging, advertising and travel which will begin to tap the potential of casual broadband communications over the public network. This effort will examine the issue of interfacing premises FDDI networks to the public MAN service. A special focus of this work is on multi-media sessions which will require coordination and management of simultaneous voice, data, image and video sessions across complex public and private transport facilities.

8. Critical Success Factors

The success of public broadband services such as SMDS will be dependent upon a number of critical factors. These include timely service introduction, availability of compatible customer devices such as bridges and routers, and development of software to provide network management and distributed applications. SMDS will need to interface with existing data communications environments in a manner which builds on embedded management and hardware platforms.

Competitive pricing of SMDS relative to dedicated private network alternatives will also be a pivotal issue for LAN-to-LAN interconnect applications. A fundamental provisioning and operations challenge of this and all future broadband services will be to control the cost of access by sharing local fiber loop bandwidth among multiple customers and among multiple services. This will raise complex regulatory concerns regarding the allocation of fiber loop access costs among the services sharing the available bandwidth. Likewise, the significant cost differentials resulting from the choice of underlying transport technologies, metallic or fiber, may tax existing cost averaging concepts.

9. Conclusions

Technology and applications trends in the customer premises environments have driven the need for strategic corporate information networks which extend beyond the bounds of single locations. The requirements of inter-premises extension of these information networks are difficult to support with currently available wideband networking services. The introduction of very high speed FDDI products will further tax the capabilities of existing network offerings to meet the needs of user applications. Availability of evolving high speed public packet services built upon a suite of standard protocols offers great promise to meet these needs in a most efficient and cost effective manner. Although early applications of these public MAN services are likely to focus on virtual private networking, the long term promise of public broadband services will be to enable casual multi-media sessions which are not currently possible. The success of these broadband services in the public network is likely to be an essential prerequisite to economically evolving to BISDN.

10. References

1. Redman, B., Schumer, M., Cushman, A.; "Local-Area Networks: Moving Beyond Local"; Local Area Communications; Gartner Group, Inc.; Stamford, CT, USA; August 30, 1988

2. Gill, R.; "LANs: The First Layer of Corporate Networking"; Gartner Group, Inc.; Stamford, CT, USA; Seventh Annual Local Area Communications Conference; July 30-31, 1990

3. Wegmann, C.; "European LANs: Geographic Breakdown"; Local Area Communications: Gartner Group, Inc.; Stamford, CT, USA; July 10, 1990

4. "Wegmann, C.; "The European LAN Environment Toward 1992"; Gartner Group, Inc.; Stamford, CT, USA; Seventh Annual Local Area Communications Conference; July 30-31, 1990

5. "Computers and Office and Accounting Machines"; Current Industrial Reports; United States Bureau of the Census; Washington, D.C., USA; 1988

6. Villars, R.; "The Emergence of FDDI: Surveying the Opportunities"; Local Area Networks; International Data Corp.; Framingham, MA, USA; October 1989

7. Draper, L., Hecht, H.; "Forecast for the 1990s: DS-1 and DS-3"; Enterprise Network Strategies; Gartner Group, Inc.; Stamford, CT, USA; June 11, 1990

8. "Quantitative Analysis of the Multiplexer Market, 1989"; International Data Corp.; Framingham, MA, USA; November 1989

9. Novak, M., Pitasi, C., Frank, J.; "ENS Scenario"; Enterprise Network Strategies; Gartner Group, Inc.; Stamford, CT, USA; February 13, 1989

10. P1396 Architectural Task Group Report; "P1396 COMBUS reference Models"

11. Bellcore Technical Advisories TA-TSY-000772, "Generic System Requirements in Support of Switched Multi-megabit Data Service"; TA-TSY-000773, "Local Access System Generic Requirements, Objectives, and Interfaces in Support of Switched Multi-megabit Data Service"; TA-TSY-000774, "Switched Multi-megabit Data Service (SMDS) Operations Technology Network Element Generic Requirements"; TA-TSY-000775, "Usage Measurement Generic Requirements in Support of Billing for Switched Multi-megabit Data Service"

Extension of KDD PLANS to International Integrated Communication Network Market

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Abstract

Business today is truly conducted on a global scale. International corporations face the important questions of how to develop more effective business strategies. More and more corporations are discovering that strategic planning hinges critically on the availability of international corporate telecommunications networks. KDD, in order to expand its operations in the network market and to cope with the rapidly increasing need to build international networks, provides support services under the general name of "KDD PLANS".

1. General

Corporate operations which depend increasingly on international partnerships, overseas production, and direct overseas investment, are no longer limited by national borders, or time and cultural differences.

In this global business environment, the position of international telecommunication is also changing from simple type telecommunications to integrated information networks. Business activities are increasingly in close cooperation with telecommunications.

2. Tendency of International Telecommunications

Tendencies are developing for the use of a variety of telecommunication media, a rapid increase of telecommunications volume, high speed transmission and advanced telecommunication systems. Corporate users require highly reliable telecommunications networks and absolute confidentiality of their communications, because they are used to transmit the will and intentions of corporations based on their business strategies.

According to the result of a market survey on international telecommunications carriers which KDD conducted with 450 corporations, more than 30% of them were considering the construction or expansion of their private networks.

In addition to the standard services provided by telecommunications carriers, these same corporations also require "network related services" such as;
engineering & consulting services to support their own network construction activities,
housing services to provide the system installation space,
network management services to support their network operation & maintenance.
It means that there is;
a tendency for an increasing need for engineering services to support individual advanced network construction as well as the ready-made network services and made-to-order network services. Especially, corporations which need to construct more advanced private networks require more consultation and engineering advice.

3. Role as International Telecommunication Carriers

Demands for corporate telecommunication networks, from now on, are bound to increase when we consider global business environments. Networks will be linked with countries which have different environments, cultures, and a variety of telecommunication networks and computers. Therefore, there will be an increasing number of problems that cannot be solved by one customer, or one carrier.

International telecommunication business has to be promoted in cooperation with all carriers concerned, not by one carrier on its own.

This means that international carriers will need to play an increasingly important role as coordinators in the construction of private networks through engineering and consulting services. To meet customers future requirements, the cooperation and relationship of the carriers concerned will be more than ever necessary.

4. KDD Service Extension

KDD's global mission is to promote flexible services relating to corporate network construction, to strengthen the support service for these networks, and to provide KDD PLANS.

KDD PLANS is the name for an entire network support service that uses the know-how, technology and subsidiary companies of KDD to fully support an advanced network structure perfectly suited for corporate users. The following services are provided under the umbrella of KDD PLANS to support corporate users in various ways.

BEST COPY AVAILABLE

Port-PLAN (Corporate Communications Network Service/Ready Made Network Service)
A pre-provided, shared usage network service that customers can use on a port rental basis.

System-PLAN (Custom System Service/Made-to-order Network Service)
A made-to-order network service that KDD constructs based on a customer's specific requirements. The telecommunications equipment is all located in the KDD station.

PLAN-E (Engineering and Consulting Service)
A support service that provides KDD's know-how and technology to help customers to construct their own network using their own telecommunication facilities.

PLAN-H (Facility Housing and Maintenance Service)
A housing and network management service of customers' telecommunications facilities installed in KDD stations.

In addition, PLAN-M is now under consideration, which is a network management and operation service for customers networks.

Figure 1 KDD PLANS CONCEPT

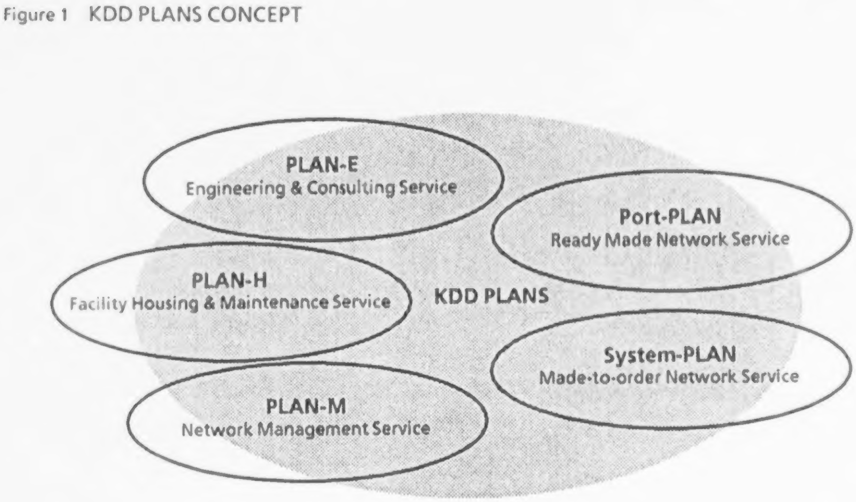


Figure 1 KDD PLANS CONCEPT
PLAN-E
Engineering & Consulting Service
Port-PLAN
Ready Made Network Service
PLAN-H
Facility Housing & Maintenance Service
KDD PLANS
System-PLAN
Made-to-order Network Service
PLAN-M
Network Management Service

5. Summary of KDD PLANS

5-1. Port-PLAN (Corporate Communications Network Service)

5-1-1 Easy to Construct Network

Port-PLAN is a network service that enables customers to create a network suited to their individual telecommunications media and volume requirements on equipment installed at KDD's operating site.

A customer can construct a network by selecting the optimum types and number of Ports (connection terminals for the system node and circuits) from a menu of different devices such as Data Ports, Packet Date Ports, Voice Ports, Facsimile Ports and Character Ports.

Setting up is simply a matter of connecting international and domestic circuits to telecommunications system ports. Similar compatible facilities are available from KDD's operating partners in UK and USA.

5-1-2 Economical Charges

The charges for the use of Port-PLAN node are structured on a per Port basis (a port provides the connection point to the service), Trunk Charges (a trunk provides the required access via the multiplexer to the international digital leased circuit), and Option Charges.

As these charges are fixed on monthly basis, by using the Port-PLAN network with leased circuits which are also monthly fixed charges, the customers will be able to stabilize their telecommunication cost. Therefore, customers' telecommunication expenses will be decreased as a whole compared to the use of the public switched network.

Port-PLAN offers other economies such as;
additional Ports and Trunks can be established as the customer's telecommunications traffic volume grows,
customers will be able to eliminate the additional capital investments to cater for future forecast traffic demand,
customers will able to avoid lack of system resources or availability caused by unforeseen increase in telecommunication traffic.

5-1-3 System Structure

Figure 2 shows system hardware components of Port-PLAN.

The communications system for Port-PLAN is made up of;
ICX (Intelligent Circuit Exchange) for digital voice and non-flow controlled data transmission service,
FC (Facsimile Concentrator), FMS (Facsimile Mailing System) and PSE (Packet Switching Equipment) for facsimile mailing service,
MSS (Message Switching System) for teletype message service, and so on.

Customers, do not need to be concerned with complicated System Structures, they can construct their own network by selecting the necessary telecommunication media, the number of Ports, and by connecting international and domestic circuits.

5-1-4 Joint Provision of Port-PLAN in Cooperation with BT and MCI

KDD provides Port-PLAN in conjunction with MCI (MCI Telecommunications Corporation) in the U.S.A. and BT (British Telecom) in the U.K.. BT and MCI have also introduce a similar service to Port-PLAN. The tricarrier's service conditions and their charge structures are also similar.

BT and MCI provide the service under different names; Primex Enhanced Service and COMMAX respectively. The BT system in London and the MCI system in Piscataway, New Jersey also provides Ports and Trunks, Tricarrier's nodes are linked with high speed digital channels via the carriers' combined worldwide network of satellite and fiber optic cable transmission facilities. The carriers will operate and maintain the system around the clock, and provide the overall management of the customer's network.
Diagram 1 shows the service element and tricarrier's charges.

5-1-5 Port-PLAN Network Examples

Figure 3 shows an example of a customer using "COMMAX" in the U.S.A. and "Primex Enhanced Service" in the U.K..

Figure 4 shows an example where a customer has added Hong Kong and Singapore Nodes to Figure 3.

Figure 5 shows an example where a customer has constructed his own dedicated systems in the other countries.

(Figure 2) **SYSTEM HARDWARE COMPONENT OF PORT-PLAN**

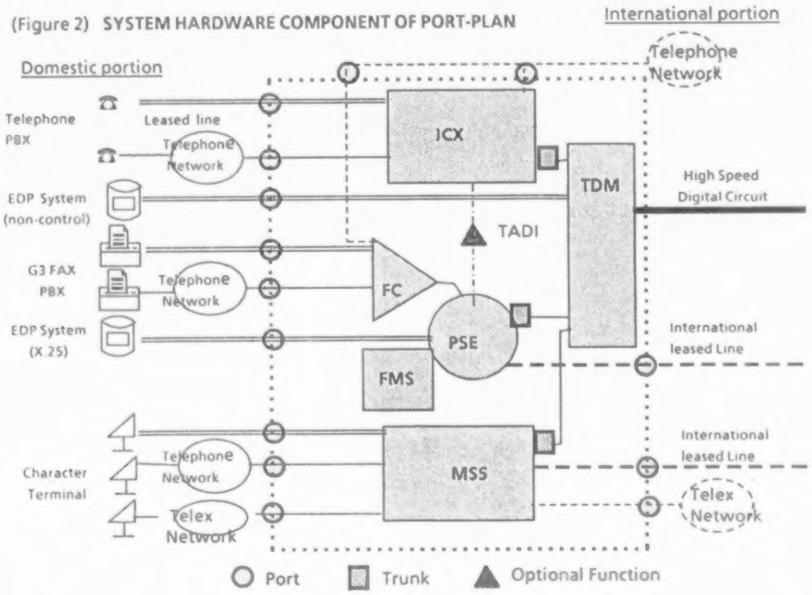

International portion
Domestic portion
Telephone Network
Telephone
PBX
Leased line
Telephone Network
ICX
TDM
High Speed
Digital Circuit
EDP System
(non-control)
TADI
G3 FAX
PBX
Telephone Network
FC
PSE
EDP System
(X.25)
International
leased Line
FMS
International
leased Line
Character
Terminal
Telephone Network
MSS
Telex Network
Telex Network
Port
Trunk
Optional Function

Diagram 1. **KDD/BTI/MCI Port & Trunk Charges**

Service Element	KDD (Port-PLAN)	BTI (PRIMEX Enhanced Service)	MCI (COMMAX)
Data Port (TDM Port)	35,000yen	£100	$250
Voice Port(Switched)	120,000yen	£575	$700
	(PSTN)125,000yen		(PSTN)$700
(Non-Switched)	65,000yen	£575	$700
Packet Data (PSE) Port	85,000yen	9.6kbps £675 64kbps £2,025	9.6kbps $1,900
Facsimile Port	170,000yen (PSTN)170,000yen	£1,250 (PSTN) £1,250	$2,250 (PSTN) $2,250
Character (MSS) Port	65,000yen (TLX)75,000yen (PSTN)85,000yen	£300 (TLX) £300 (PSTN) £300	up to 110bps $ 350 300bps $500 1,200bps $1,000 2,400bps $1,500
Voice Trunk	25,000yen	£150	$750
Packet Data (PSE) Trunk	100,000yen	£1,100	$2,200
Character (MSS) Trunk	80,000yen	£675	up to 110 bps $600 300bps $750 1,200bps $1,250 2,400bps $1,750
TADI Trunk	100,000yen	£1,250	$5,000

Figure 3 Port-PLAN NETWORK EXAMPLE #1

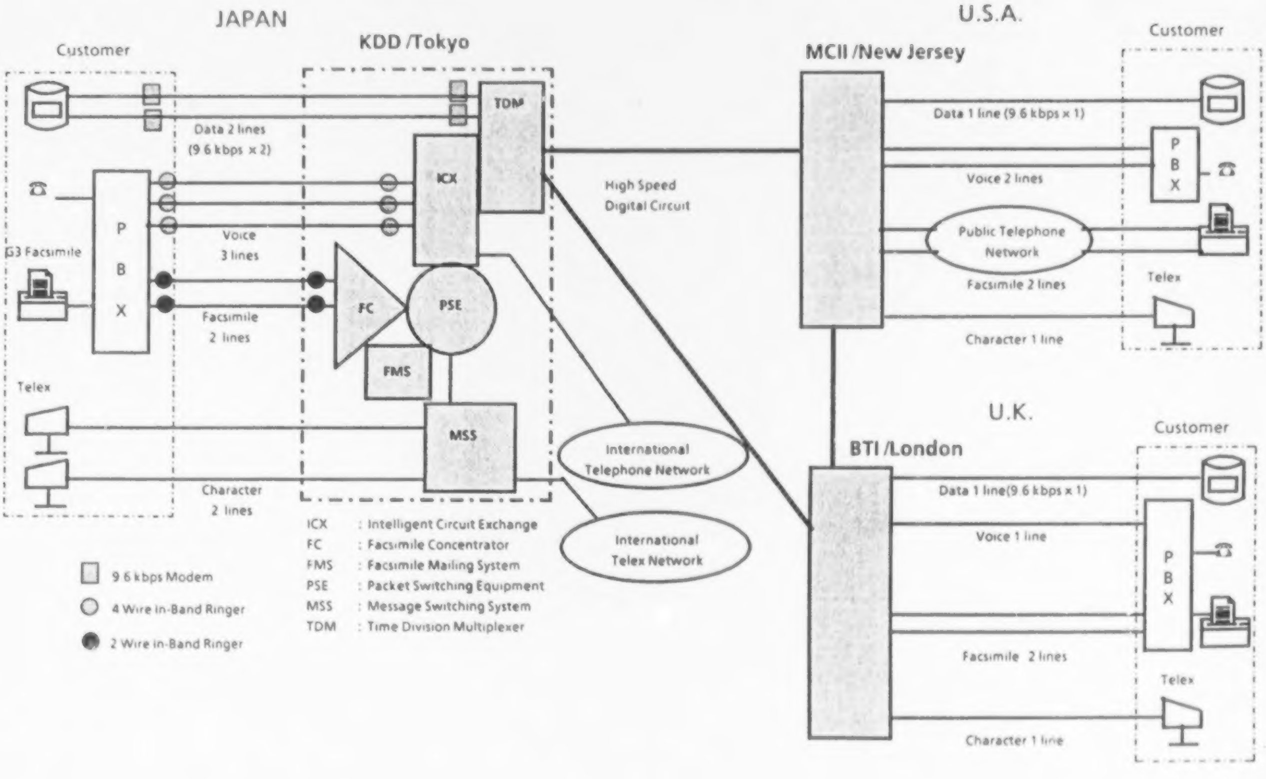

JAPAN
Customer
KDD /Tokyo
Data 2 lines
(9.6 kbps × 2)
TDM
ICX
Voice
3 lines
G3 Facsimile
P
B
X
FC
PSE
FMS
Facsimile
2 lines
Telex
MSS
Character
2 lines
High Speed
Digital Circuit
International
Telephone Network
International
Telex Network
ICX : Intelligent Circuit Exchange
FC : Facsimile Concentrator
FMS : Facsimile Mailing System
PSE : Packet Switching Equipment
MSS : Message Switching System
TDM : Time Division Multiplexer
9.6 kbps Modem
4 Wire In-Band Ringer
2 Wire In-Band Ringer
U.S.A.
MCII /New Jersey
Customer
Data 1 line (9.6 kbps × 1)
P
B
X
Voice 2 lines
Public Telephone
Network
Facsimile 2 lines
Telex
Character 1 line
U.K.
BTI /London
Customer
Data 1 line(9.6 kbps × 1)
Voice 1 line
P
B
X
Facsimile 2 lines
Telex
Character 1 line

Figure 4 PORT-PLAN NETWORK EXAMPLE #2

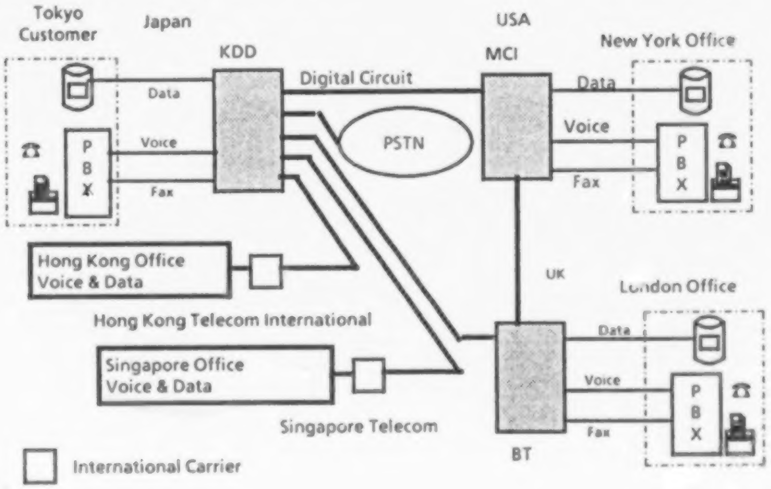
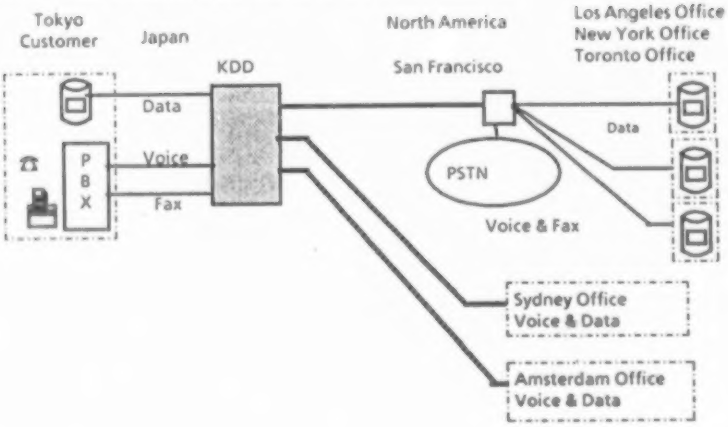

Tokyo Customer
Japan
KDD
Data
Voice
Fax
PBX
Digital Circuit
PSTN
USA
MCI
New York Office
Data
Voice
Fax
PBX
Hong Kong Office Voice & Data
Hong Kong Telecom International
Singapore Office Voice & Data
Singapore Telecom
UK
London Office
Data
Voice
Fax
PBX
BT
International Carrier

Figure 5 PORT-PLAN NETWORK EXAMPLE #3


Tokyo Customer
Japan
KDD
Data
Voice
Fax
PBX
North America
San Francisco
PSTN
Los Angeles Office
New York Office
Toronto Office
Data
Voice & Fax
Sydney Office Voice & Data
Amsterdam Office Voice & Data

5-2. System-PLAN

System-PLAN is a made-to-order network service in which KDD constructs a network based on a customer's specific requirements.

System-PLAN is a fully supported network service in which KDD handles everything from the basic planning and setting up of the network operation, and maintenance and management after the system is in the place. The telecommunication equipment is all located in the KDD operation center.

The network products can be quite complex but thanks to KDD's experience and technical know-how in multivendor integration, an advanced network tailored to a customer's needs can be built for any kind of media or function.

5-3. PLAN-E (Engineering & Consulting Service)

As the business environment becomes more and more demanding so does a company become more dependent on fast, efficient and reliable communications. With the widening choice of service and rapid technology change the design and implementation of telecommunications networks has become a highly specialized skill and the deployment of specialist staff to undertake these tasks becomes a highly uneconomic proposition for companies.

5-3-1 Service Description

KDD has put together PLAN-E (Private-link Advanced Network Engineering Service) as a solution to this practical problem. PLAN-E is a total engineering service which will support customers in the design of international networks, assisting them with details at every stage.

KDD's technology and experience will help customers construct networks with a design and implementation program best suited to their needs. KDD will be pleased, of course, not only to help customers build an entire system, but also to support them in any stage of the project as follows.

Network Planning;
After analyzing customers' goals and conditions, KDD will design a network which will meet these needs and be suitable for the companies' potential for future development, PLAN-E provides total process management, taking care of every element of the network project, including communication analysis, use-situation analysis, domestic and international communication systems surveys, writing up of user manuals, and more.

Network Design;
KDD will design everything necessary for customers' network structures, from circuit selection to system design. KDD will also help evaluate the proposal submitted by various manufacturers.

Network Procurement;
When constructing customers' networks, KDD will place orders, make inspections, make export arrangement for equipment installed in Japan and abroad, and will also arrange the international circuits.

Network Implementation;
KDD will make arrangements with communication corporations at home and abroad, Guiding and participating in construction.

Network Test;
KDD will plan and manage testing of network connections at both ends.

Customers can request support for anything they may need help with. KDD will also handle turnkey construction, in which they take care of all work right up to the inauguration of customers made to order network.

5-3-2 Service Advantages

It is necessary that international telecommunications networks should be constructed in consideration of the situation pertaining in the distant country. However, KDD supports the construction of customers' self designed networks in global partnership with carriers in other countries and by using KDD's subsidiary companies located around the world.

KDD also takes account of the current situation and future prospect of the customer's business, supports network construction by multi vendors, and designs the most suitable telecommunication facilities for the customer, in consideration of cost, availability, and compatibility.

5-4. PLAN-H (Facility Management Service)

It will be impossible to create an international business vision without a corporate telecommunications network, often referred to as the central nervous system of a corporation. The continuity and development of international business will be influenced greatly by the construction and proper maintenance of a highly reliable telecommunications network. Such a network requires specialized knowledge, experience and advanced maintenance.

The key to success for future telecommunications networks will be the utilization of professional facilities and knowledge which will provide everything from the space to house the customers network to regular maintenance and operation. PLAN-H (Private-Link Advanced Network Facilities Housing Service) is the service which can provide all of these.

5-4-1 Service Description

PLAN-H is a service which will install customer provide facilities inside the KDD operation site. There KDD will provide 24-hours-a-day and 7-days-a-week operation, supervision, and maintenance for the facilities and its circuits. The KDD operation site is a safe and highly reliable structure, constructed under the latest technology. Operations are performed by skilled

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and experienced staff who are on the job day and night.

5-4-2 Content of Main Services

Provides necessary support for facility installation.

24-hours-a-day supervision of facilities and its circuits.

In the event of a facility or circuit failure, KDD will take immediate action to effect restoration.

KDD will maintain end-to-end responsibility for customers circuits and will interface between other vendors and overseas carriers.

On request, KDD will provide statistical reports of system failures, and perform other management services.

According to the customers requirements, KDD will also provide various support services such as network design, consultation for the selection of network facilities, connection test and so on.

5-4-3 Service Advantages

Relieves Office-Space problem;
The problem of office space shortage has become worse year after year in Japan, until it has become a major corporate issue. PLAN-H offers the space for installing customers' communication facilities as well as providing the ideal environment.

Safe and Discreet;
The KDD operation site, where customers' facilities will be installed, was designed in order to house telecommunications facilities. The building uses seismic structures and power-supply equipment designed to eliminate the possibility of power outage, the best environment imaginable for telecommunications equipment. The building is under strict security, meaning that all communications are protected.

Drastic reduce of corporate manhour for networks;
PLAN-H provide a 24-hours-a-day system for operating, supervising, and maintaining customers' telecommunication facilities and its circuits. It will not be necessary to have special staff assigned to customers' communication facilities, reducing personnel costs.

Quick and Smooth Trouble Shooting;
KDD maintain customers' facilities and circuits. This means that should a problem occur, KDD will act immediately to isolate and restore the problem, and maintain customers' telecommunication as efficiently as possible.

A Perfect Network Test;
Prior to the customers' telecommunication network operation, all connections must pass rigorous tests. KDD has cultivated partnership with communication companies world wide. These relationship and KDD's long experience makes it possible to perform effective checks before the customers' system goes into operation.

Flexibility;
By using facilities installed in KDD operation sites, circuit lead times will be shortened. Customers' network systems can be easily changed or expanded.

5-4-4 Charges

One-time Charges;
This is the charge for the installation work done by KDD, the cost of necessary training for operations and maintenance provided by KDD, and parts used for installing facilities and starting operations.

Monthly Recurring Charges;
These are the charges for the environment for customers facilities, its opeation and maintenance. It includes labor, use-of-space, air-conditioning, electrical sources, and power supply.

6. Conclusion

More and more strategic, high quality, advanced and flexible corporate networks with tighter specifications are required in the global business environment. However, the construction of international corporate networks which satisfy the corporate customers' requirements are more and more difficult without special knowledge and know-how.

As the general procedure, domestic networks will be constructed in the first stage. And as the extension of the networks, and international extension will be added.

However, we tend to be faced with many problems such as:
difference in regulations and general rules regarding telecommunications services conditions between Japan and distant countries;
other difficulties in these countries which can not be estimated from domestic experience.

It is KDD PLANS that are designed to solve all of these problems. KDD will support the international corporate customers' business through these network offerings.

THE ROLE OF RADIO BYPASS OF LANDLINE IN DEVELOPING COUNTRIES

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ABSTRACT

Privatisation; regulatory changes, and advances of technology have significantly improved the economies for the use of cellular and other radio based technologies such as CT2 and DECT as the primary telephone network. By the end of the decade we can expect to see substantial applications of this type throughout Asia, not only supplementing wireline networks, but supplanting them.

Of the approximately 500 million phones in the world today, less than 58 million are in Asia Pacific excluding Japan. In other words, just about 2.5 billion people, half the world's population owns about 12% of the world's phones. These figures serve to remind us that there is clearly a huge requirement for telephone communications in Asia. and it is my personal view that over the next two decades the number of telephones in Asia will grow a figure close to the 500 million currently in use throughout the world. The prospect we project over the next 20 years is for the creation of 20 new companies in Asia each the size of AT&T. At first sight this might seem ambitious as this would require a continued compounded annual growth of around 11.5% which is nearly double the average annual regional growth in GNP of 6% over the past decade.

Clearly we have some significant reasons for projecting this level of growth and these fall into broadly four categories, privatisation of telephone companies, change in regulatory environment, technological change, and finally relative cost reduction in telecommunications. The Asia Pacific region represents a series of dramatic success stories in terms of the newly industrialised countries, but we still have huge areas, and huge populations for whom telephones are still well out of reach, both physically and financially.

The first change I would like to discuss is Privatisation. Privatisation of telephone companies has a major impact on developing countries as it allows one of the very few government departments which makes money to start to re-invest revenues in its own telecommunications infrastructure and not just provide revenues to finance other non telecommunications projects. Telecommunications are, in many cases, one of the very few cash generators of government who will often divert telecoms revenues to more urgent public health and welfare programs. Re-investment in telecommunications has been impressive in the Newly Industrialised countries and sadly lacking in the least developed countries. The list of countries in Asia actively moving towards privatisation of the telephone company is substantial.

The second change is the substitution of regulated tariffs by competition. This has an important impact in developing countries as it separates basic wireline services, and related tariffs from value added services such as cellular. Any third world country has a strong motivation for political reasons to provide very low cost basic domestic services, often at rates which a purely commercial operation would find unattractive. A non government owned public company providing a service which has no government funding and who's rates reflect commercial rather than political objectives, may well escape the public criticism which would be directed at a monopolistic government owned wireline operator. Cellular networks are often regarded as elitist and represent a diversion of much needed government funds to serve small privileged minorities. Separation of cellular infrastructure and other value added services into the private sector side steps the problem. Further, deregulation will attract investors, if foreign ownership is permitted, infrastructural investment attracts foreign investment in a manner which is politically acceptable in an increasing number of countries. There has been substantial interest by most major American and European Telcos to make just such investments. Indeed, infusion of foreign capital into telephone networks is in my view likely to be the significant factor in extending networks in Asia. Indonesia, Thailand and Bangladesh have taken huge strides in this respect.

Basic wireline services tend to be regarded as a national asset and are generally viewed as an essential tool of governmental control. Thus while cellular may be regarded as a candidate for deregulation and privatisation, and possibly foreign participation, basic wireline services may be retained in a government owned regulated structure.

The third change is the change of technology. Developing technologies have played an important part in the process. However the most remarkable technology development for Asia has been the growth of radio based technologies which were not anticipated as having significant role in developing or third world countries. Cellular radio, CT2, DECT, PCN all offer an interesting challenge for a number of reasons related to the structural difficulty of installing copper wire in countries which have very little urban infrastructure, ducting, main sewerage and water supply, electricity and so on, and which are busy creating densely populated cities with substantial building construction. If you look at any of the major cities of Asia, for the last 20 years it has been like living in a building site, road construction, office buildings, residential apartment complexes are shooting up everywhere. Not only is this an environment which is very hostile to wireline, but it is one in which there is no infrastructure of ducting which in developed countries represents a substantial national asset. I frankly can't believe that over the next two decades, Asia is going to spend one trillion dollars installing two billion kilometres of copper wire in ducts which for the most part haven't been built yet. It is worthy note that the duopoly review in the UK clearly identifies the value of radio based technologies in substitution of local loop.

Cellular and related technologies have a number of very useful advantages with respect to wireline. The first is that a cellular site is distance insensitive, a fixed cellular subscriber may be 1 kilometre or 15 kilometres from a base site - the cost of serving that subscriber is identical. This makes cellular an extremely attractive alternative in rural or suburban areas. When one installs a wireline, the network operator takes a gamble on how much revenue the subscriber will generate, but his costs are fixed. With cellular, an operator is installing traffic capacity - a certain number of erlangs. If, in a particular area, subscribers don't use the phone very much, the operator can increase the number of subscribers without additional infrastructural cost, thus, with even moderate clairvoyance skills, the network operator can grow to meet traffic demands and confidently predict returns on each part of the investment.

Theft of physical outside plant, and theft of airtime becomes a significantly more manageable problem.

Finally the maintenance of outside plant becomes far easier, mainly because you don't have any. Maintenance of base site equipment may be somewhat more complex however so clearly not everything is a free ride, and the training of technicians and engineers is fundamental to our business.

The fourth change is in the relative cost of infrastructure. In 1985 when we started our cellular network in Hong Kong the incremental cost of infrastructure per subscriber was $1,500 and the cost of a cellular phone was US$3,000 representing a total investment per subscriber of US$4,500.

Today, using the same analogue AMPS and TAC equipment we have 70,000 subscribers and we see infrastructural costs somewhat reduced - to around $1,200 and subscriber units to around $900 ex-factory cost. With the introduction of GSM we anticipate infrastructural costs under US$1,000 per subscriber and digital AMPS around the same, or slightly lower. By 1995 with the introduction of half rate codecs we are hopeful of seeing a further reduction to around US$600 per subscriber, and subscriber units at under $500. Thus we are reasonably optimistic that planned evolution of equipment should allow us to use figures of under US$1,000 per subscriber total cost by the end of the decade.

The use of CT2 and DECT technologies, we believe will allow for even more significant cost reductions, allowing for cost of infrastructure and subscriber unit in the region of US$500 by mid decade.

Clearly these costs represent significant progress with cost reduction, which are even more significant when we consider real dollars as opposed to the constant dollar examples I have provided. We see no reason to believe that similar savings will apply to wired infrastructure which we believe generally represent US$1,000 to $1,500 investment per line. Indeed we expect wired local loop to steadily increase in cost.

We have concluded that on a purely cost basis, cellular technology represents a real alternative to wired networks in countries which do not have significant investment in existing wired infrastructure and ducting. However we are further attracted to the technology, by the clear advantage of speed of roll out. Clearly a cellular infrastructure can be rapidly installed and expanded, and customers can be added to the network almost immediately a customer walks into one of our point of sale facilities, and we see no reason why provision of service should not be completed within 24 hours on any cellular network. Clearly, similar speed of connection is only possible in a wired network where all houses have been prewired, which is very seldom the case in developing countries. Connection times in many Asian countries is measured in years.

Clearly, to expand the concept, further equipment evolution is required. We already have transportable cellular telephones which very closely resemble landline desk telephone instruments. These we feel are appropriate to use in fixed environments. What we are working on now is the development of cell site equipment which takes advantage of the fact that fixed subscribers do not require hand-off, and can achieve significant cost reductions as a result. Such sell site equipment may require the partitioning of the network in mobile and fixed segments however this will permit a tiered price structure for subscriber usage charges. Thus in a mobile network, the degree of mobility becomes an incremental charge to the user. Currently we recognize distance, call duration and time of day as the dimensions of a tariff structure, so now we can add a new dimension - degree of mobility. Somewhat to our surprise the development of suitable cell site equipment grew out of our requirements for PICOCELLS to provide in building coverage in some of Hong Kong's night-spots, shopping complexes and tunnels, but we may find the most useful application in villages in Bangladesh. The only common element appears to be that neither applications requires intercell hand-off.

As a further extension of the rural application we are examining the use of a DECT microcell concept, with a overlay of cellular AMPS or TACS to provide backhaul. Once again the concept was one we evolved for possible use in the UK PCN environment, and which we are now attempting to apply to Bangladesh and possibly Philippines and elsewhere.

While we would regard these concepts as experimental, we have a high degree of confidence in the outcome. We have just completed installation phase 1 of what will grow to be a nationwide cellular AMPS system in Bangladesh, we are constructing a very similar network in Cebu in the Philippines, and have made a proposal in conjunction with GTE for a 450 MHz nordic cellular system to provide nationwide service in Poland. Together these represent an investment of more that $250 million. I would emphasis just two points, the first is that we have deliberately avoided the use of existing rural telephone equipment - as we believe that rural applications will not support an adequate research and development funding, and product volumes will be two low to achieve necessary economies of scale. We believed there must be a way to capitalise on the huge funding applied to traditional equipment markets. The second point is that these networks are not intended to supplement the wireline network - we believe they will supplant it. In East Germany, Deutsche Bundespost is rapidly deploying C Net and D Net equipment to provide basic telephone service until more traditional fibre optic based networks can be installed. We take exactly the same view with regard to our proposals for Poland and our installations in Bangladesh.

Emerging radio technologies, AMPS, TACS, NMT, GSM. DECT, CT2, CT3 will continue to force the pace of lower cost local loop bypass alternatives. We don't believe that cabled local loop will disappear, it will however evolve, but we do believe that for countries without extensive infrastructure, radio based local loop today presents a viable and attractive alternative, not only because of the evolution of the regulatory, administrative and political environments in which those systems, will exist. Systems grow best and fastest in environments which provide the greatest freedom to grow. Highly regulated monopolies, however desirable, have one self evident feature, and that is to preserve the present. Change is often viewed more of a threat than an opportunity as it results in significant need for re-training, re-engineering and accelerated depreciation. Today we live in a period of intense technological and regulatory change. As communicators, our role is to seize the opportunities that these changes offer to us, and no where are those changes more intensive and fundamental than in the Asia Pacific region. We have the responsibility to manage change in a manner most beneficial to the communities we serve. The only thing which does not change is the inevitability of change itself.

Telecommunications Policies for Developing Countries: An Incentive-Based Analysis

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Abstract

The proliferation of communications technologies and services, plus the dramatic growth of the information sector and demand for telecommunications, have contributed to changes in the organization and regulation of the telecommunications sector in many industrialized countries. Faced with technological change and tremendous unmet demand for telecommunications services, developing nations are also introducing reforms in their telecommunications sectors.

The purpose of this paper is to examine the structural and managerial problems facing the telecommunications sector in developing countries, and to suggest reforms that could improve investment opportunities and incentives for innovation and modernization. While definitive results are not yet available, it is evident that a variety of models may be appropriate, depending on several factors including the political and economic environment, regulatory history, and size and distribution of the population to be served.

1. Information Gaps

The past quarter century has been marked by dramatic technological developments in telecommunications and computing, and the growing importance of information in all aspects of human life. Access to information, and to the facilities to produce, store, and transmit information is now considered vital to development, so that the classifications "information rich" and "information poor" may mean more than distinctions based on GNP or other traditional development indicators.

The "information gap" between industrialized and developing countries is reflected in their access to telecommunications resources. Although there are now more than 600 million telephones in the world, it is estimated that two-thirds of the world's population has no access to telephone services. New York City alone has more telephones than the entire African continent. Nearly three quarters of the world's population live in countries with ten telephones or fewer for every 100 people; over half the world's population lives in countries with less than one telephone per 100 people. Lower income countries show dramatically limited access to telecommunications. The highest telephone density among these countries is seven telephones per thousand people, while in many cases there is no more than one telephone per thousand inhabitants.

Of course, telephones are not evenly distributed throughout the population in developing countries. Not only do wealthier people have greater access to telephones, but most of the telephones are located in urban areas. As a result, the telephone density is likely to be much lower in rural areas, where the need for telecommunications is more critical because of the difficulty in communicating over longer distances.

2. Telecommunications in the Development Process

Distance represents time, in an increasingly time-conscious world. In economies that depend heavily upon agriculture or the extraction of resources (lumber and minerals), distance from urban markets has traditionally been alleviated only with the installation of improved transportation facilities, typically roads. Yet transportation links leave industries without the access to information which is becoming increasingly important for production and marketing of their commodities.

Another disadvantage faced by many developing countries is economic specialization. As they strive to diversify their economies, timely access to information becomes even more critical. For example, in a manufacturing environment that increasingly depends upon out-sourcing of component parts and just-in-time delivery to assembly plants, the further the production facilities are located from markets, the more some other economic characteristic (for example, lower wages) must compensate for the time/distance problem. In new industries specializing in the provision of information goods and services, reliable telecommunications infrastructure can make geography and distance irrelevant. (For example, American Airlines' ticket data is keypunched in Barbados; legal data for Lexis is entered in South Korea. Indian engineers transmit software code to Texas Instruments from Bangalore.)

As developing countries also join the global market by attracting multinational corporations, establishing joint ventures, and developing service industries, they soon recognize the need for a reliable and modern telecommunications network.

The ability to communicate instantaneously can facilitate the development process by increasing:

-- efficiency, i.e. the ratio of output to cost;

-- effectiveness, or the extent to which development goals are achieved;

-- equity, i.e. the distribution of development benefits throughout the society.

Recent research has shed considerable light on the contribution of telecommunications to economic development. Several studies sponsored by agencies including the International Telecommunication Union (ITU) and the World Bank have shown that telecommunications can facilitate many development activities including agriculture, industry, shipping, education, health and social services. (see, for example, Pierce and Jequier, 1983; Saunders et al., 1983; Hudson, 1984; ITU, 1986)

3. The PTT Bottleneck

Today about 80% of the world's population has no access to reliable telecommunications, despite the availability of VSATs and other relatively low cost technologies (VHF, UHF, rural subscriber microwave systems, cellular radio, etc.) Given the demand, the reduction in costs, and the potential benefits, why is the diffusion rate so low? There are many reasons, but the major problem is that in most cases the PTT acts as a gatekeeper or bottleneck that prevents customers from obtaining equipment and services. Thus the government-operated utility model that was adopted to protect the public interest now acts as a constraint to retard growth of the telecommunications sector, and as a result, the economy as a whole.

Two examples illustrate the result of the bottleneck. First, the number of television sets has greatly exceeded the number of telephones in most developing countries. This imbalance is generally not the result of government priorities, but of either lack of awareness of the role of telecommunications, or lack of coordinated planning in delivery of services, or unwillingness to give up political and economic control.

In a second example we can compare access to microcomputers with access to VSATs. The reduction in cost and increase in computing power of microcomputers have been accompanied by advances in telecommunications that should make affordable voice and data communications available virtually anywhere. Yet access to computers is through a competitive marketplace, whereas telecommunications services are provided in most countries through access to a single national network.

In order to understand the diffusion of these technologies, it is necessary to identify the various participants and their roles in the diffusion process. While a microcomputer is a standalone technology (despite the fact that it can be linked to other computers through a network), a telephone set and a VSAT are useless by themselves -- they require a network. Thus, users cannot meet the need for telecommunications alone by buying a telephone set, a cellular phone, or a VSAT. They must be able to connect to a network, and the PTT controls access to the only network. If the PTT is not responsive to consumer needs, as if often the case, frustrated consumers remain without service. The same consumers can usually buy standalone technologies such as computers and VCRs.

4. Strategies to Increase Efficiency

To increase access to voice and data communications in developing countries, it is necessary to get rid of bottlenecks where possible, and to create incentives for carriers to meet customers' needs and to raise capital for expansion. Two major strategies are required. The first involves restructuring to introduce autonomy and privatization. The second involves liberalization, or introduction of competition in various facilities and services. The following are suggested steps and strategies to restructure the telecommunications sector.

Figure 1 shows the various stages of privatization and liberalization, and illustrates the current status of several industrialized and developing countries.

Figure 1: Stages of Autonomy/Privatization and Liberalization in Selected Industrialized and Developing Countries

	DEGREE OF AUTONOMY/PRIVATIZATION				
DEGREE OF COMPETITION	Govt Dept	Govt Enterprise	Autonomous Govt Company	Mixed Ownership Company	Private Company
1. None	Nepal	Tanzania			
2. CPE Only		Thailand			
3. VANS Only					
4. CPE & VANS		Singapore	Malaysia Sri Lanka		(Phil)
5. Bypass					
6. facilities/ pub. network					
7. 5 + 4			Mexico Australia	Brazil Argentina	(NZ)
8. 6 + 5					(Canada)
9. 6 + 5 + 4					USA (Japan) UK

4.1. Management Autonomy

The first strategy for creating incentives to improve efficiency and innovation in the telecommunications sector is to create an autonomous organization operated on business principles. The end goal in many cases may be privatization as part of a national strategy to turn government operated enterprises over to the private sector, or simply as a means of freeing the sector to raise its own capital and to introduce management policies that are rarely tolerated in a public enterprise.

However, in countries with a PTT structure, there may be several steps on the path to privatization. An intermediate phase of autonomous public ownership may be required as a result of pressure by influential public entities and/or unions. British Telecom, for example, went through this process. Australia has opted for autonomous public corporations to operate its public switched network. Several developing countries have chosen this model including Singapore, Nigeria, Fiji and now Mexico.

Others see the autonomous government-owned corporation as simply an intermediate step. New Zealand has announced that it will privatize. Malaysia intends to fully privatize the autonomous corporation it established in 1987. Sri Lanka has also established a Telecommunications Corporation, as an intermediate step toward privatization.

The difficulty with a government owned corporation is that it may still be subject to many political and bureaucratic constraints even if granted considerable autonomy. Malaysian telecommunications still suffer from government and union influences that reduce incentives. India has established a government corporation to serve Delhi and Bombay. While service quality has improved substantially, the government still dictates many policies that prevent the corporation from acting efficiently to meet customer needs.

4.2. Mixed Public/Private Corporations

Some countries have gone a step farther by including private investment, often through foreign carriers. Several Caribbean and South Pacific nations operate their international telecommun-ications as joint ventures with Cable and Wireless. Belize operates its international facilities with the participation of British Telecom. Argentina has invited the participation of Telefonica of Spain.

Another approach is subscriber investment through share capital. Brazilian subscribers, for example must become shareholders in their regional telephone companies. This approach has raised much of the capital needed to construct the network. But the experience in Brazil shows that mandatory subscriber investment is not alone a solution. First, Brazilian shareholders have no say in the policies and priorities of the telephone companies, as shareholders would (if organized) in a regular corporation. Second, the government has not allowed the regional companies to function autonomously, but instead has impounded their revenues and allocated annual funds rather than letting them reinvest their own profits. The result has been deterioration of the plant in the highly populated areas and very limited expansion in rural areas. However, the new president has promised major changes including some privatization.

4.3. Fully Private Corporations

At the far end of the continuum are countries that have fully privatized their public network carrier(s). British Telecom is an often cited example, as the corporation was privatized through the issuance of shares in 1984. Japan's NTT intends to fully privatize. In the developing world, Chile has privatized its phone system. The Philippines has several private telephone companies, but poor coordination within the sector, which is dominated by the publicly owned PLDT.

In general, private corporations offer the greatest commercial benefits in terms of efficiency, competitiveness and capital acquisition. They also are leaders in technology development and innovation in equipment and services. It should be noted, however, that restructuring and/or privatizing telecommunications may not achieve its desired objectives without some form of regulatory oversight. See section 7 below.

5. Strategies to Increase Innovation and Access

5.1. Introducing Competition

Privatization is increasingly coupled with liberalization, or the introduction of competition. The U.S. has taken this strategy the farthest, with competition allowed in both services and facilities with the exception of the local loop (and in many cases short haul, i.e. intraLATA, toll traffic).

Developing countries are generally reluctant to introduce public network competition because they believe that there are significant economies of scale, and therefore duplication would be wasteful. However, most agree that competition can be successfully introduced in customer premises equipment (CPE) and value added networks or services (VANs).

Yet lack of capacity is a serious problem in many developing countries, and cannot be solved simply by selling telephones and other equipment on the open market. Several strategies may be used to provide capacity where direct competition is considered unacceptable:

5.2. Other Strategies

o **Resale:** Third parties may be permitted to lease capacity in bulk and resell it in units of bandwidth and/or time appropriate for business customers and other major users. This approach may be suitable where some excess network capacity exists (e.g. between major cities or on domestic or regional satellites).

o **New Services: Franchise or Competition:** The introduction of a new service may be accelerated by issuing licenses for franchises. This approach has been used for cellular radio in Argentina and Mexico, for example. It allows foreign investors with the necessary capital and expertise to provide the service more quickly than it could be offered through the PTT.

Satellite services such as data communications may also be offered through one or more private licensed carriers. Again, this approach is likely to get service installed much more quickly than through the PTT. For example, private banking networks using VSATs have now been authorized in Brazil.

Both of these technologies may be considered a form of bypass, although they may introduce services previously unavailable. The country must weigh whether the advantages of licensing the service to private carriers outweigh any dangers of creamskimming. An advantage of both these technologies is that they provide services to important consumer groups that were not previously available. For example, cellular radio may be used for fixed communications to provide public call offices and community telephones where they were not previously available, as well as to provide service to more affluent drivers. VSATs may provide important data links for important national industries such as petroleum and banking.

Yet there are dangers of distortion if policy makers do not carefully frame incentives. In Malaysia, for example, the price of installing a cellular radio is 1.5 times the national per capita GNP, thus excluding rural communities which were also supposed to benefit from the service. (Wellenius et al., 1989) Policies may be frmaed to generate funds for other priorities. For example, carriers may charge license fees and/or operate base stations or uplinks for the private networks. They might also require that a percentage of the revenues of these services be allocated to implement other services, such as low cost fixed cellular outlets or educational programs and thin route telephony via satellite.

o **Local companies:** Although in most countries there is [illegible] single carrier that provides both local and long distance services, it may make sense to delineate territories that can be served by local entities. In the U.S., the model of rural cooperatives fostered through the Rural Electrification Administration (REA) has been used to bring telephone service to areas ignored by the large carriers. Local enterprises are likely to be more responsive to local needs, whether they be urban or rural. An example of this approach in urban areas is India's Metropolitan Telephone Corporation established to serve Bombay and Delhi. Service quality has improved substantially, although limited autonomy from the government has hindered the pace and scope of innovation. Local companies also provide telephone service in Colombia. Cooperatives have been introduced in Hungary.

A disadvantage of this approach is the need for local expertise to operate the system, which is likely to be in particularly short supply in developing countries.

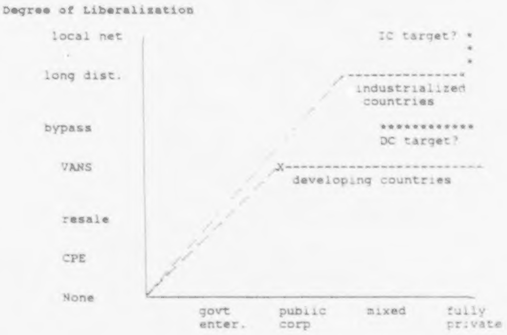
o **Franchises for Unserved Areas:** Another approach to serving presently unserved areas is to open them up to private franchises. Large carriers may determine that some rural areas are too unprofitable to serve in the near term. However, this conclusion may be based on assumptions about the cost of technologies and implementation that could be inappropriate. A more innovative carrier willing to use more appropriate technology such as rural radio systems or small earth stations and to cut costs by hiring local people rather than bringing in outside staff, may be able to run the system at a profit. In Alaska, for example, small telephone companies operate local service in villages where earth stations were installed by Alascom. The state of Colorado is considering competitive franchising of territory that the Bell Operating Company says is prohibitively expensive to serve.

6. Targets for Developing Countries

The telecommunications sector is critical to development, but suffers from insufficient capital, poor management, little innovation, and tremendous pentup demand in most developing countries. The above analysis has indicated means to respond to the need for incentives to improve efficiency, innovation, and responsiveness to customer demand. If these strategies are implemented, there will be increased profits for reinvestment and the sector will be more attractive for investors.

Figure 2 shows targets for privatization and competition based on this analysis. This chart represents stages of privatization and liberalization. Countries may progress through the various stages of privatization, or may simply restructure to reach their final target in one step. The order for introducing competition is not necessarily hierarchical, but most countries choose to introduce competition in CPE first, then in resale and VANs, and then authorize bypass services and possibly competitive long distance services.

Figure 2: Targets in Privatization and Liberalization



The dashed lines (---) represent typical paths for industrialized and developing countries.

The "***" lines represent targets.

For industrialized countries, the target in most cases should be fully privatized carriers, and competition at least to the stage of public long distance networks. Some are also considering competition in the local loop, but in most cases, basic local service will remain a monopoly for the foreseeable future.

Developing countries typically privatize in phases, starting first with an autonomous government-owned corporation. Some intend to privatize completely; others prefer to retain some government ownership in a joint venture. Competition in CPE appears viable for all developing countries. Those with indigenous manufacturing or assembly capacity need not provide the equipment through the carrier, but could make it available through independent distributors. Competitive VANs also appear appropriate for developing countries, as does resale of excess trunk capacity to major users. In many cases, bypass may be an appropriate means to introduce new services to business customers (e.g. VSATs, cellular radio) if licensing includes fees which can be used as additional revenue to upgrade the public network.

Long distance competition in the public network is probably not justified in most developing countries at present because of the dangers of wasting scarce resources on redundant capacity and difficulties in interfacing with the local network. Countries with domestic satellites can introduce long distance competition by allowing the satellites to be used even where terrestrial capacity exists. This approach in India and Indonesia, for example, would enable subscribers to bypass the bottlenecks in major cities.

Thus for developing countries, the target should be at least a mixed enterprise in most cases, with full privatization with regulatory oversight appropriate in many cases. Competition should exist at least for CPE and VANs, and further competition may often be justified.

The critical elements include:

full internal autonomy: to raise capital, manage operations, hire and dismiss personnel;

competition: in those parts of the network where the benefits are clear in terms of price, diversity, and quality;

oversight: to ensure that quality and standards are maintained, rates are reasonable, and priorities match national goals.

7. Policy and Regulation

7.1. The Fallacy of Deregulation

The implicit assumption of the PTT model appears to be "What is good for the PTT is good for the country." Stated another way, since the PTT is part of the government, and the government exists to serve the needs of the public, the PTT must therefore be serving the public interest. An implied corollary is that there is no need for participation by users, and besides, they wouldn't have the expertise to make any informed contribution.

The changing telecommunications environment is often referred to as "deregulation." In fact, virtually everywhere but the U.S. and Canada, the result of changing the telecommunications structure has been the need to introduce regulation where none existed. Under the PTT model, there is no separate regulatory function: decisions on frequency allocation, standards, and prices are typically made by the PTT or a related arm of the government.

When an autonomous structure is established, there becomes a need for oversight. This is particularly true in a monopoly environment, to ensure that the single provider does not abuse monopoly power in setting rates or discriminating between customers. However, even a competitive environment is likely to require some oversight to ensure that service providers are competing fairly, and that their collective activity is serving the national interest.

The solution need not be the creation of a regulatory commission on the scale of the FCC. The models of OFTEL (U.K.) and AUSTEL (Australia) may be more appropriate in size and scope. It may be possible to develop incentives so that the carrier(s) become largely self-regulating: for example, price caps with built-in incentives for efficiency, or rate increases tied not only to productivity but also to quality of service. However, there will still be a need for monitoring to ensure that these terms are met.

The functions that a regulator will need to perform or at least supervise include:

Pricing: Where competition exists, the marketplace may serve as a means of ensuring that prices are reasonable. However, for monopoly services, or where demand far exceeds capacity, regulatory intervention may be necessary. Typically, the concern is that prices will be set too high, either to obtain excess profits or to ration scarce capacity. High prices may also conflict with national goals of providing affordable access to services.

However, oversight may also be needed to ensure that prices are not set too low! Government pressure not to raise rates may leave the carrier without adequate resources to maintain and upgrade facilities. For example, some U.S. rural cooperatives face severe pressure from their members to maintain very low rates. They have found that it is important to have arms length oversight to ensure that rates are not set too low.

Explicit Subsidies: Internal cross-subsidies are often used to provide affordable services in less profitable areas. With the introduction of competition, it is important to make such subsidies explicit where they remain necessary, in order that a dominant carrier cannot use them to engage in predatory pricing.

Quality of Service: With deregulation comes the potential for degradation of service in less profitable areas, as carriers strive to expand and upgrade the most profitable services. Concern about the deterioration of rural services has been expressed, not only at the state level in the U.S., but also by consumers in Canada, the U.K. and Australia. Monitoring of service quality is likely to be important in developing countries, where one of the main objectives of restructuring the sector is to improve quality of service. It may also be possible to tie service quality standards to other incentives such as pricing flexibility.

Criteria for Access by Multiple Providers: Where service competition is allowed, oversight will be required to ensure that all have equal access to the network, and that the provider of facilities does not enjoy an unfair advantage if it also offers services.

Standards: Equipment standards are required to ensure that equipment is compatible and of acceptable quality. An impartial standards agency will ensure that a dominant carrier or supplier does not introduce standards that unreasonably discriminate against other vendors.

8. Conclusion

The goal of providing telecommunications to contribute to national development has major implications for how telecommunications is organized and managed within a country. It requires an active government policy to ensure that telecommunications plans and services are designed to meet national goals. It also requires flexibility and innovation in services, equipment and pricing to respond to user needs. In other words, management must encourage and reward innovation, must emphasize marketing, and must be open to new arrangements for providing equipment and services.

It is important to recognize that the telecommunications network is more than simply a financial asset and a source of revenue. It is a vital strategic resource for the nation. Meeting the challenges posed by new and converging technologies can enable developing countries to maximize the benefits of this strategic resource.

REFERENCES

AT&T. The World's Telephones. Bedminister, NJ, 1989.

Blair, Michael L. "VSAT Systems in Developing Countries." PTC '88 Proceedings. Honolulu: February 1988.

Hudson, Heather E. Communication Satellites: Their Development and Impact. New York: Free Press, 1990.

Hudson, Heather E. When Telephones Reach the Village: The Role of Telecommunications in Rural Development. Norwood, NJ: Ablex, 1984.

Hudson, Heather E., ed. "Innovative Strategies for Telecommunications Development." Special issue of Telematics and Informatics. Vol. 4, No. 2, Spring 1987.

Hudson, Heather E. and Lynn York. "Generating Foreign Exchange in Developing Countries: The Potential of Telecommunications Investments." Telecommunications Policy, September 1988.

Hukill, Mark A. and Meheroo Jussawalla. "Telecommunications Policies and Markets in the Asean Countries." Columbia Journal of World Business. Vol. XXIV, No. 1, spring 1989.

INTELSAT. Annual Report. Washington, D.C., 1989.

International Telecommunication Union. Information, Telecommunications, and Development. Geneva: ITU, 1986.

"International TV Set Count." VideoAge International. February/ March 1986.

Maitland Commission. The Missing Link. Geneva: International Telecommunication Union, 1985.

Mayo, John K., G.R. Heald, S.J. Klees, M. Cruz de Yanes. Peru Rural Communication Services Project Final Evaluation Report. Washington, D.C.: Academy for International Development, 1987.

National Telecommunications and Information Administration. Telecom 2000. Washington, D.C., 1988.

Parker, Edwin B., Heather E. Hudson, Don A. Dillman, Andrew D. Roscoe. Rural America in the Information Age: Telecommunications Policy for Rural Development. Lanham, MD: University Press of America, 1989.

Pierce, William B. and Nicolas Jequier. Telecommunications for Development. Geneva: International Telecommunication Union. 1983.

Saunders, Robert, Jeremy Warford, and Bjorn Wellenius. Telecommun-ications and Economic Development. Baltimore: Johns Hopkins, 1983.

Tietjen, Karen. AID Rural Satellite Program: An Overview. Washington, D.C.: Academy for Educational Development, 1989.

Wellenius, Bjorn, Peter A. Stern, Timothy E. Nulty, and Richard J. Stern, eds. Restructuring and Managing the Telecommunications Sector. Washington, D.C.: World Bank, 1989.

THE MEDIUM-TERM MANAGEMENT PLAN (FY1991-95)

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ABSTRACT

The main trend in technology and services in the telecommunications industry in the coming years is likely to be the growing need for more "intelligent" and "personal" services. NTT's Medium-term Management Plan(FY1991-95), which was released in March 1990 and which embodies these forecasted developments, details the direction of the Corporation's management for the first half of the 1990s and aims at responding flexibly to rapid changes in future operating environments.

This paper will focus on ideas for the digitalization of the NTT network as outlined in the Medium-term Management Plan.

1 Present Service and Investment Trends

The year 1990 is highly significant for NTT in two ways. First, it is now five years since the Corporation was privatized, and second, 100 years since telephone services began in Japan.

Fig.1 shows the extent of NTT network services today. 1989 marked a milestone in NTT history when the number of telephone subscriber lines reached 50 million. During the same year, NTT also introduced more advanced services in response to the increasingly sophisticated and diversified demands of its customers. Rapid growth in telephone services such as facsimiles were another highlight.

Earlier, in April 1988, NTT had begun operation of the world's first wide-area commercial ISDN (Integrated Services Digital Network). NTT has steadily enlarged its ISDN services, and by March 1991 NTT's ISDN will comprise almost 35,000 circuits throughout Japan.

Turning to investment, NTT has always channeled funds into equipment and R&D investment in order to provide better and more advanced services to its subscribers. NTT's digitalization plan is one

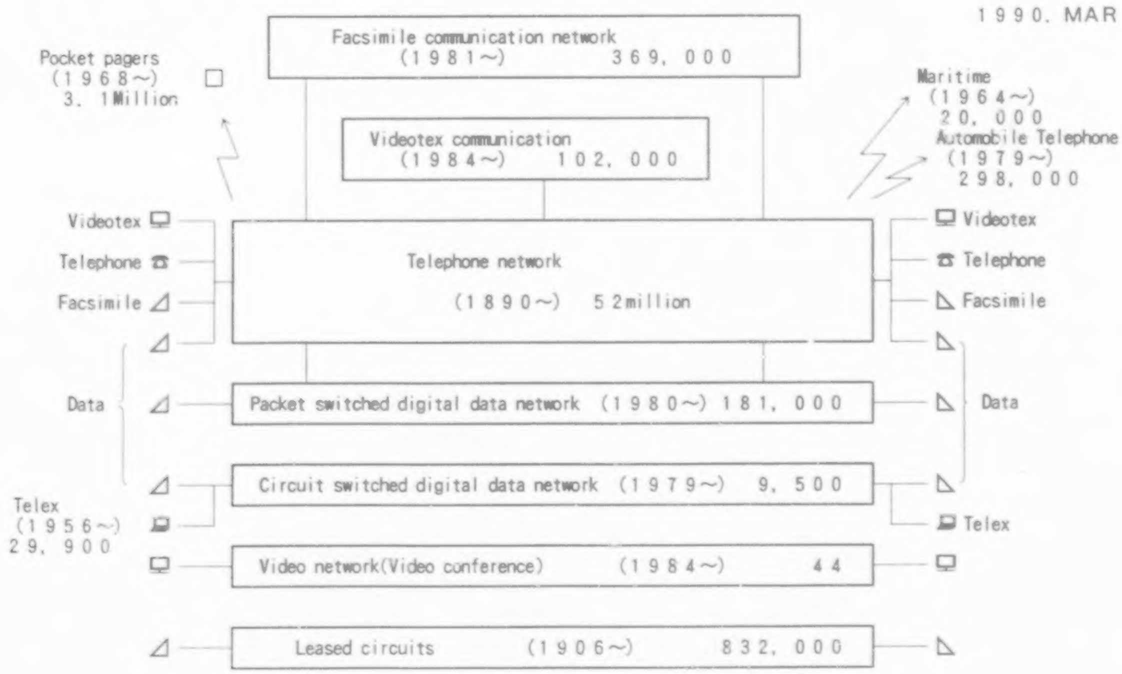
1990. MAR
Facsimile communication network (1981~) 369,000
Pocket pagers (1968~) 3.1Million
Videotex communication (1984~) 102,000
Maritime (1964~) 20,000
Automobile Telephone (1979~) 298,000
Videotex
Telephone
Facsimile
Telephone network (1890~) 52million
Data
Packet switched digital data network (1980~) 181,000
Circuit switched digital data network (1979~) 9,500
Telex (1956~) 29,900
Telex
Video network(Video conference) (1984~) 44
Leased circuits (1906~) 832,000

Figure 1. Network Services in NTT

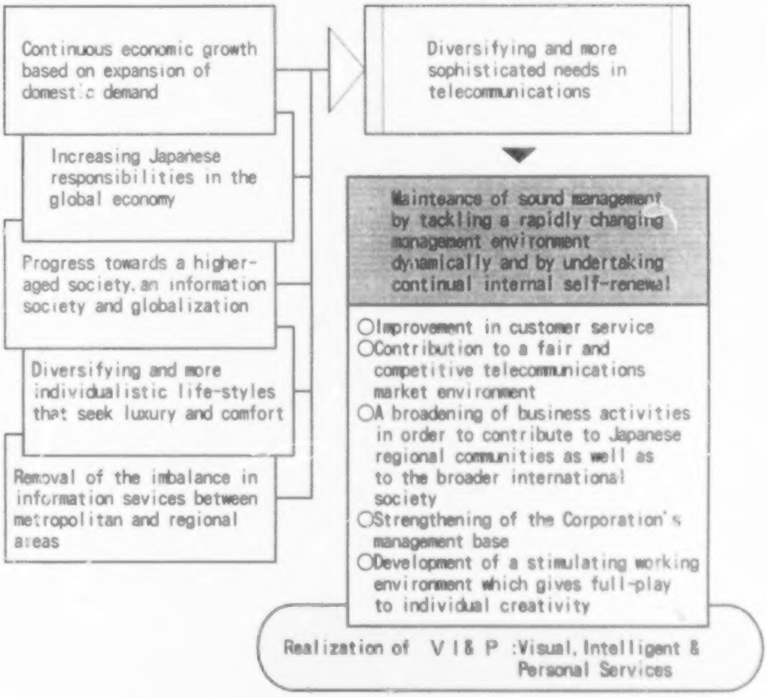
Continuous economic growth based on expansion of domestic demand
Increasing Japanese responsibilities in the global economy
Progress towards a higher-aged society, an information society and globalization
Diversifying and more individualistic life-styles that seek luxury and comfort
Removal of the imbalance in information sevices between metropolitan and regional areas
Diversifying and more sophisticated needs in telecommunications
Mainteance of sound management by tackling a rapidly changing management environment dynamically and by undertaking continual internal self-renewal
○Improvement in customer service
○Contribution to a fair and competitive telecommunications market environment
○A broadening of business activities in order to contribute to Japanese regional communities as well as to the broader international society
○Strengthening of the Corporation's management base
○Development of a stimulating working environment which gives full-play to individual creativity
Realization of V I & P :Visual, Intelligent & Personal Services

Figure 2 Economic and Social Prospects for the 1990s and the Principles of NTT's Medium-term Management Plan

example of the ongoing process of modernizing and upgrading of its telecomminications facilities. Investment in research and development receives similar attention. Over 1.7 trillion yen has been earmarked for investment purposes in the current fiscal year. The portion designated for the digitalization plan has grown considerably.

II The Medium-term Management Plan (FY1991-95)

In looking ahead to the 1990s,telecommunications needs are anticipated to be more diversified and sophisticated (see Fig.2). To respond effectively to this challenging operating environment, NTT believes it is essential to provide a greater variety of services that are readily available throughout Japan and that allow customers wider choice in accord with their diversity of needs.

Accordingly, NTT has formulated a new corporate philosophy that embraces the challenges of the future telecommunications market. Namely NTT seeks, on the basis of technological development from the international perspective,to maintain its superior services and high reputation amongst its users, and to contribute to a more affluent lifestyle corresponding to modern culture.

NTT intends to vigorously perform the major roles it has been designated in the Japanese telecommunications industry. Our major objectives include digitalization of the network nationwide, steady upgrading of research and development capacities, removal of the imbalance in information services between metropolitan and regional areas (nation-wide service extention), maintenance of the public-utility component in telecommunications services, and contribution to an open and fair environment in the telecommunications market in Japan (see Fig.3).

NTT's response to future social changes will be thorough and far-reaching: the Corporation will institute comprehensive internal reforms and maintain sound management operations. To perform the roles expected of NTT the following management policies have been incorporated into the Medium-term Management Plan (FY1991-95), ending March 31, 1995:

1. Improvements in customer service which respond to the ongoing sophistication of Japanese society;

2. Contribution to a fair and competitive

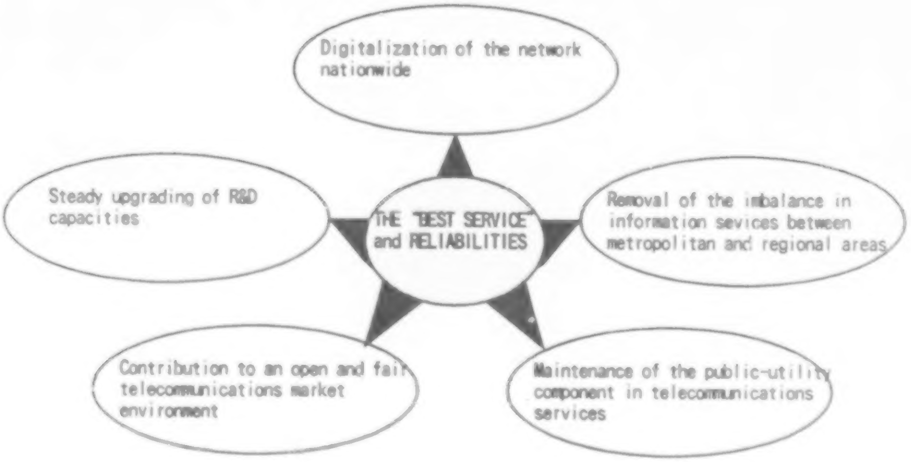
Digitalization of the network nationwide
Steady upgrading of R&D capacities
THE "BEST SERVICE" and RELIABILITIES
Removal of the imbalance in information sevices between metropolitan and regional areas
Contribution to an open and fair telecommunications market environment
Maintenance of the public-utility component in telecommunications services

Figure 3. The Roles of NTT

telecommunications market environment;

3. A broadening of business activities in order to contribute to Japanese regional communities as well as to the broader international society;

4. Strengthening of the Corporation's management base to cope with changes in the operating environment;

5. Development of a stimulating working environment which gives full-play to individual creativity.

III Implementation of the Medium- and Long-term Digitalization Plan

As shown in Fig.4, it is becoming increasingly important to early construct the digital communication network as a concrete mean for these principles in the Medium-term Management Plan. The digitalization of telecommunications networks is already being carried out on a full-scale basis in the United States and Europe, due to its provision of more diverse and advanced services at lower rates with greater stability and reliability. NTT is determined to see a crucial technological leap. There are three main aims in the digitalization process in respect to the management of NTT.

1. Improvements in Customer Service

As Japanese society becomes more sophisticated, both the demand for higher quality services and customer awareness of the potential of telecommunications services are raised to a high level. NTT is therefore working to upgrade the quality of its services to meet this situation.

NTT's services will be upgraded by improving general customer service, lowering rates (less than 200yen as base rate for long-distance calls), diversifying the rate structure (a discount rate system, single-rate calls for a designated times, etc.), and by developing various new services and various application methods.

2. Contribution to a Fair and Competitive Market Environment

NTT realizes that the expansion of a competitive market will stimulate activity in the market, improve the quality and variety of services avalilable, and promote management efficiency. In order to offer customers a genuine choice between NTT and the new common carriers, an ID emit function had to be added to local exchanges. NTT has made the ID emit function a major priority. The earlier we can realize a competitive, or what we prefer to call an environment on equal footing, the faster will the consumer benefit from more convenient services.

Digitalization will obviously help in accelerating additions of the ID emit function to local exchanges, although digitalization in large numbers will be difficult to accomplish in a short space of time. We have therefore, in addition to the digitalization project, adopted a policy of adding the ID emit function to crossbar exchanges.

3. Efficient Operations and Management

Digitalization offers opportunities for rationalization such as centralized maintenance (as many diagnosis and repair operations can be performed remotely), allowing us to use our best and brightest staff to pursue our policy of "Best Service" for our customers.

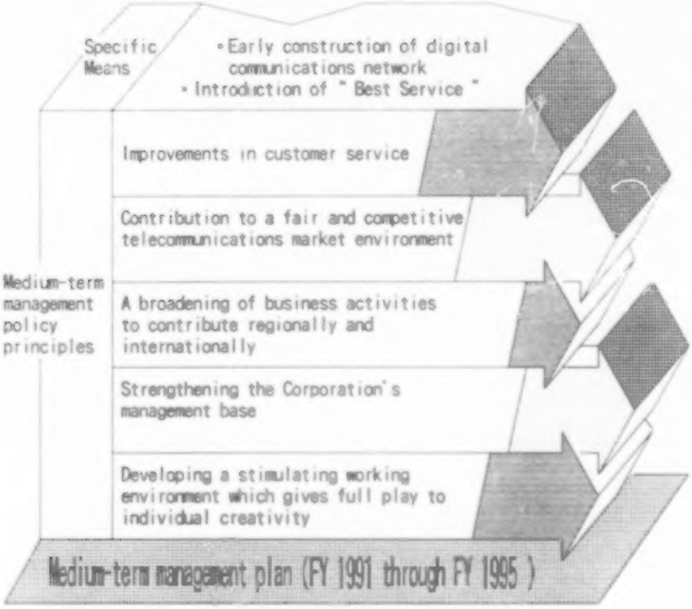
Specific Means
• Early construction of digital communications network
• Introduction of " Best Service "
Improvements in customer service
Contribution to a fair and competitive telecommunications market environment
Medium-term management policy principles
A broadening of business activities to contribute regionally and internationally
Strengthening the Corporation's management base
Developing a stimulating working environment which gives full play to individual creativity
Medium-term management plan (FY 1991 through FY 1995)

Figure 4. The Five Principles of the Medium-term Management Plan

To achieve these three aims as mentioned above, demands are increasing for upgraded telecommunications services offering diverse and advanced functions at a reasonable price and with high reliability and security. In order to meet such demands, NTT must build a digital network that features 1) flexible accommodation of user needs at a low cost, 2) simple network configuration and 3) easy operation and management. Especially, in order to strengthen the software component of the telecommunications network, replacement of crossbar local exchanges with Stored Program Control (SPC) switching will be completed by the mid-1990's.

With this change, it will become possible to provide a broader range of more sophisticated telephone services, diversifying the rate structure, with new software. In addition, users will be able to use ID codes to connect with any other telecommunications carrier, because the electronic exchange system will eliminate current limitations in the crossbar system.

Digitalization of all subscriber exchanges including analog electronic exchanges will be completed before the turn of the century toward the coming high-speed broadband ISDN era.

Regarding inter-city circuits, work on major inter-city networks will be carried out first, for the early realization of upgraded network functions, to increase efficiency of operations such as design, maintenance, and network control. We are aiming to have all principal cities connected by digital circuits by March 1993. Full digitalization should then be completed three years later, by the end of fiscal 1995.

In addition to the conversion to digitalization, telecommunications networks in need of handling the advanced and diversified needs of society will require introduction of high-speed broadband networks, that is, "Fiber-to-the-Home", and promotion of the Equipment Grand Design.

1. Fiber-to-the-Home

NTT will accelerate laying of optical cables for subscribers in preparation for a Fiber-to-the-home program. In the major commercial centers of Tokyo, Nagoya and Osaka where demand for business-related services is strongest, NTT will initiate an opticalization program in designated areas and buildings, for example, in cases of high-rise office complexes.

2. The Equipment Grand Design and More Effective Investment

Dramatic advances have been achieved in optical and digital technology in recent years.
Networks that carry traffic representing a variety of services to extensive areas must be structured so that fast and flexible responses to changes in subscriber demand can be initiated. At the same time, disaster-related and technical breakdowns must be prevented as they undermine user confidence in the reliability of the services being offered.

The medium- and long-term Equipment Grand Design was devised for the purpose of creating a network capable of responding to the varied and advanced needs of users. NTT's basic approach to achieving greater efficiency in future plant and equipment investment projects will be to achieve maximum benefit while minimizing investment outlays.

IV Completing the Medium-term Management Plan

The Medium-term Management Plan is scheduled for completion in fiscal 1995 (see Table 1). At that time, NTT users can expect to benefit in the following ways:

- More diverse and reliable services at lower rates will be readily available nationwide, thereby contributing to a richer life and culture.

- Users will have access -- via NTT equipment -- to the telecommunications services of any common carrier and not be obligated to use those of NTT (almost all subscribers will have access to ID -emit capability).

For Japanese society and the economy in general, realization of the plan will have the following advantages;

- The digitalization program and the construction of high-speed broadband networks will upgrade the nation's telecommunications infrastructure and enhance Japan's international competitiveness in the field.

- The expansion in domestic demand in Japan in recent years has generated more production activity in Japan, which in turn is underpinning economic growth. This growth is creating the need for more diverse telecommunications services and lower service rates, all of which serves to promote social and economic development.

- The imbalances in availability of information services between metropolitan and regional areas in Japan will be removed and more efficient and balanced nationwide development will be achieved.

- Research into leading-edge technology will promote economic and social development and improves Japan's international competitiveness.

NTT employees will also benefit since the plan details specific measures for the creation of an exciting work environment that allows individuals to fully utilize their potential.

During the first half of the 1990s, NTT is likely to be confronted by a number of profound challenges, both domestically and internationally. In order to successfully overcome such challenges, and at the same time create an enterprise with vision and energy, NTT has committed itself to a major objective: implementing the "Medium-term Management Plan."

Table 1. Perspective-Five Years from Now

	I T E M	FY 1990	FY 1995
Service	Telephone rates [the longest distance for 3 minutes]	¥ 330 (¥ 280 from Mar. 19)	less than ¥ 200
	Number of subscribers	52.3 million	app. 62 million
	Number of pushbutton lines (market saturation)	11.6 million (22%)	app. 21 million (33%)
	Number of call-waiting service subscribers (market saturation)	5.1 million (10%)	app. 13 million (20%)
	Number of "Free Dial" subscribers	130 thousand	app. 400 thousand
	Number of subscribers for INS-net 64	6 thousand	app. 750 thousand
	Percentage of public telephones using telephone cards	65 %	100 % nearly completed by FY1993
	Number of mobile telephone service areas (percentage of areas)	1.843 cities, towns and villages (57%)	app. 2800cities, towns and villages (86%)
Research & Development	Research & development cost (ratio to income)	¥ 240 billion (4.2%)	app. ¥ 300 billion(app. 5%)
	Number of researchers	7.300	app. 10 thousand
Financial Data	Income	¥ 5.75 trillion	¥ 6.7 trillion
	Outstanding debt	¥ 3.78 trillion	less than ¥ 3 trillion
Personnel	Employee	267 thousand	230 thousand
	Number of subscribers per employee (productivity index)	196 (100)	270 (138)

NETWORK STRATEGIC PLANNING IN TELECOM CANADA

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1. ABSTRACT

This paper explains and describes the Strategic Planning Process in Telecom Canada, with particular emphasis on Network Strategic Planning. The approach to Strategic Planning described here is general enough to be applicable to other telecommunication administrations.

2. INTRODUCTION

This paper is about Strategic Planning, with particular reference to Network Strategic Planning at Telecom Canada. Telecom Canada is an association of Canada's major telecommunications companies which has helped its members build one of the most advanced national communications networks in the world. Together, these companies provide a voice, data and image network, nationally linking Canada's businesses and residences, in urban as well as rural and remote areas. For almost sixty years, a leadership position in technological innovation and development, within Canada and internationally, has been the result of a long held common aim: to provide reliable, cost-effective telecommunications services for all Canadians.

The last couple of decades have been a period of extraordinary changes for Telecom Canada in a number of different areas such as technology, regulation, competition, and customer expectation. Changes bring challenges and in responding to these challenges Canadian telecommunication companies have re-examined and redefined their goals and objectives, and developed new strategies to achieve them.

This paper examines the way Telecom Canada responds to these challenges at a Strategic level.

3. STRATEGIC PLANNING

The words "Strategic Planning" have different meaning for different people. To ensure a common understanding, the concepts and elements of strategic planning as used in this paper, will first be discussed.

3.1 CONCEPTS AND DEFINITIONS

Start with the concept of "Planning", on which corporations and managers spend a good amount of time and effort. It is something done in advance of taking action; that is, it is anticipatory decision making. (1) Planning ensures that the results of actions meet intentions, and takes place at all levels in the corporation, whether management or non-management.

Strategic Planning is not something separate from the process of planning or management. On the contrary, it is woven into the entire fabric of management. At the risk of over simplification, all management can be viewed as having a strategic and an operational component. The relative emphasis on the strategic component is generally a function of the management level. For example, the strategic component is highest at the Board of Directors or executive levels, and much lower at the sales and support levels of management. (Figure 1)

Strategic Planning is that element of a manager's job and of the organization's function that deals with the willful management of change rather than simple reaction to it. It stresses organizational purposes, choices concerning external environmental factors, is future oriented, and it is this all encompassing emphasis that, lends it its strategic imperative.

THE STRATEGIC COMPONENT OF MANAGEMENT

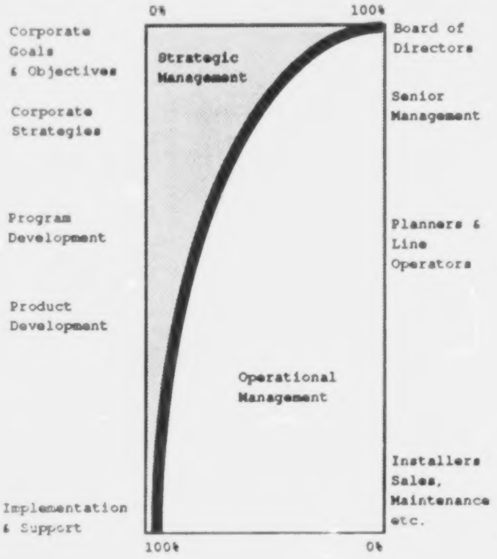

FIGURE 1

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Although Strategic Planning is applicable to any level of management, this paper is primarily about Strategic Management and Planning at the corporate level. Henceforth, Strategic Planning or Management will be taken to mean Corporate Strategic Planning/Management.

Corporate Strategic Management, is top management's role, responsibility and prerogative. Strategic Planning is backbone support to Strategic Management. Thus, its essential character is organizational direction setting. Often, Long Range considerations are important to Strategic Planning; so much so that Strategic Planning is sometimes (mistakenly) called Long Range Planning. However, Strategic Planning should not be confused with a plan of action for the future (such as for example, a five or ten year plan). It should rather be seen as high level decisions ***now*** so that the enterprise may ***have*** a future.

Strategic Planning is difficult to define precisely, but an operational definition suitable for this paper might be:

> *Strategic Planning is the proactive determination, through a thorough awareness of the environment, of the goals and objectives of an enterprise and the adoption of courses of action to achieve these goals & objectives.*

Most definitions, even perhaps including this one, are weak in that they do not sufficiently differentiate between Strategic Planning and other types of planning that routinely go on in an organization. This makes the concept somewhat difficult to grasp. Quite often the problem is that the definition and process of planning has been taken for granted rather than well thought out.

Tables I and II are offered as help in clarifying the meaning of Strategic Planning.

Table I attempts to illustrate the characteristics of Strategic Planning. The table suggests that the key identifiers of the strategic concept are an emphasis on the environment of the firm, looking in from the future searching for a formulation of the right things to do, directed by a vision of future states, and its search for synergy, wholeness and effectiveness. (2)

Perhaps an indication of what Strategic Planning is ***not*** will further clarify what it ***is***. (see Table II). A certain amount of contemplation is required to fully internalize these ideas; this exercise is left to the reader.

3.2 STATUS OF STRATEGIC PLANNING IN CANADA

Strategic Planning appears to be well accepted in Canadian organizations as a key element of the corporate management process. It has not always been so; for following an initial period of excitement and euphoria after its introduction, it fell into disrepute among corporate executives as a process that merely produces plans but no action. This, of course, was no fault of Strategic Planning, but of the commitment to the plan and the follow-through with action. It is important therefore, that the Strategic Planning Process be designed to lead naturally and logically into implementable plans and actions. In telecommunications in Canada, Strategic Planning is well accepted as a key tool of senior management.

TABLE I

PLANNING AND STRATEGIC PLANNING CONTRASTED *

STRATEGIC PLANNING	**OTHER PLANNING**
Emphasis on the the environment	Emphasis on the enterprise
Oriented toward change	Emphasis on stability
Vision directed	Follows a blueprint
Inductive and integrated	Deductive and analytical
Open and external focus	Closed and internal focus
Anticipates changes	Extrapolates from the past
Current decisions based on looking in from the future	Current decisions based on looking from the present
Entrepreneurial and action oriented even when there is ambiguity	Inaction when there is ambiguity
Emphasis on innovation and creativity	Emphasis on the tried and tested
Synergistic	Univariate
Effectiveness oriented	Efficiency oriented
Patterns are in a stream of decisions	Decisions are made and carried out

* Adapted from (2)

TABLE II

STRATEGIC PLANNING - WHAT IT IS NOT

Strategic Planning is NOT:

1 the identification of a series of future decisions

2. the forecasting of sales/markets/services & plans to meet them

3. the aggregation of functional plans

4. the compilation of a n-year implementation plan for capacity expansion and product introduction

3.3 STRATEGIC PLANNING - HOW IS IT ACCOMPLISHED?

Three obvious questions at this stage are:

1. What should Strategic Planning be applied to?

2. When should Strategic Planning be done?

3. How is Strategic Planning done?

Strategic Planning is applicable to any area of focus that

- is strongly related to the overall organizational purposes, and,
- significantly involves uncontrollable environmental forces that affect organizational performance.

Thus, in the modern telecommunications context, Strategic Planning is clearly applicable to such areas as Network Planning and Marketing. For most telecommunications entities in North America (and indeed in the world today) the scope of applicability is in fact much wider and includes Finance, Human Resources, Organizational Structure and Culture, and Information Systems.

Strategic Planning is a process that leads to a Strategic Plan. A Strategic Plan is required whenever management decisions, actions and results are so out of time with external influences as to endanger the corporation, or when opportunities for corporate betterment are being missed.

Strategic Planning is not only a process, it is also an attitude, a corporate culture and frame of mind that is attuned to the environment to recognize threats to and opportunities for the organization. Procedures should be in place for the timely escalation of strategic matters to the appropriate decision making authority. For such there can be no specified times.

In addition formal, periodic (say annual) reviews of the adequacy and relevance of existing strategies should be conducted and the results documented. Such reviews will indicate the need for major revisions to the strategic plan, and it is important that such needs be acted upon. There is often a tendency for delay, for many of the issues with which Strategic Planning deal do not have the immediacy of operational or day-to-day planning, and therefore tend not only to be low in priority, but to be also viewed as something that will look after themselves. However, the effectiveness with which operational activities are meeting organizational purposes can only be judged if such purposes have been properly defined.

Strategic Planning has to be an organized, intensive, collective effort by a knowledgeable and responsible body that can speak for the enterprise. It thus must involve corporate decision makers and direction setters.

There could be a tendency too, for Strategic Plans, once made up, to stay as ivory tower efforts that never get transmitted to the implementation level. Such planning is obviously ineffective for setting organizational direction. To avoid this eventuality, Strategic Planning must be made an inherent and natural part of the management planning process, and means for assessing the effectiveness with which corporate goals are being met must be built in.

4. A STRATEGIC PLAN

Good Strategic Planning consists of a number of essential elements:

- Statements of Mission and Goals
- Corporate Business
- Environmental Analysis
- Situation Assessment
- Strategic Thrusts
- Process and Organization

A brief discussion of each of these elements follow.

4.1 THE MISSION STATEMENT

The Mission Statement is a short, clear, concise enunciation of the organization's reason for existing, and implicitly defines the organization's broadest strategic choices. It provides the essential criteria used for developing a consistent set of corporate goals.

It is quite possible that in time a Mission Statement may need reformulation. A good Mission Statement should state the organization's raison d'etre; establish the individuality of the firm; define the business that the company wants to be in (not necessarily what it is in); and be exciting and inspiring (1).

4.2 GOALS

Goals are statements of the means by which the Mission is to be achieved. There may be a number of goals in pursuit of a basic mission and may be stated in either quantitative or descriptive terms. They should ideally be broad statements, as opposed to specific objectives and/or strategies. However, goals should be achievable, and may be quantified for those portions of the organization where this is meaningful.

4.3 CORPORATE BUSINESS VISION

A Business Vision accompanies and expands on the Mission. It describes in broad terms the new world of opportunity for the organization, addressing such areas as future markets, technology advances, opportunities and problems associated with future products and services, and the role the enterprise could play in the new era. It is the Vision that gives life and meaning to the Mission, and provides a frame of reference for the Environment Analysis and Situation Assessment.

4.4 ENVIRONMENTAL ANALYSIS

An Environmental Analysis provides a detailed description of the current and future climate affecting the organization and its business interests. Since the environment is

STRATEGIC PLANNING PROCESS

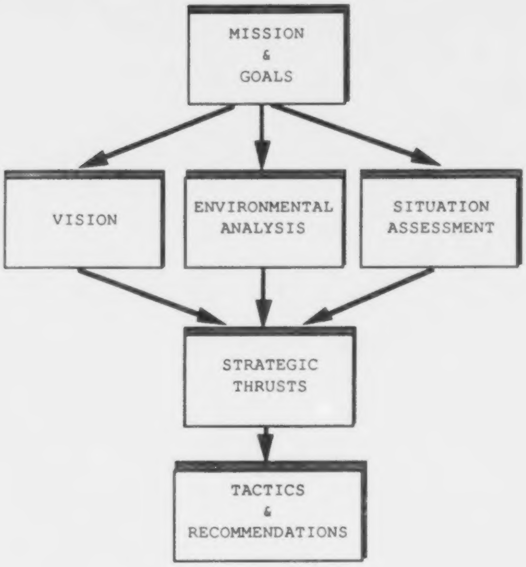

FIGURE 2

multidimensional, the analysis is necessarily so too and might cover areas such as sociodemographic changes, economic trends, technology, public policy and regulation, industry structure, and competition.

The Environmental Analysis should be objective, and not judgmental and suggestive of decisions.

4.5 SITUATION ASSESSMENT

This is an evaluation of where the organization is in relation to its goals. It includes an assessment of the company's internal strengths and weaknesses, and identifies external threats and opportunities. A comprehensive situation analysis is an essential and important part of Strategic Planning. It provides necessary information for formulating steps to overcome obstacles in achieving the corporation's goals.

4.6 STRATEGIC THRUSTS

Strategic Thrusts are the nuts and bolts of the Strategic Plan. They generate specific tactics and action items that can be converted into projects and plans for implementation.

4.7 PROCESS AND ORGANIZATION

The strength of an organization are its people, and its achievements are the result of their working towards common goals. The development of the Strategic Thrusts has to be complemented by an assessment of the organization, corporate culture, and management processes that will facilitate the acceptance and implementation of the strategic thrusts.

5. STRATEGIC PLANNING IN TELECOM CANADA

5.1 THE TELECOM CANADA ORGANIZATION

Telecom Canada is an association of nine Canadian telecommunications network carriers and one satellite carrier. Together, and through the coordinated effort of Telecom Canada, these companies provide nationwide telecommunication services. Although, where applicable, the individual member companies are responsible for planning their internal networks, Telecom Canada has centralized responsibility for planning those elements and aspects of the networks that affects more than one member company, or for providing connectivity to the USA and overseas. This is performed by Telecom Canada's Central Staff organization, which is made up entirely of employees "on loan" from member companies, and is based at Telecom Canada headquarters in Ottawa.

Telecom Canada's organization and the relationship between its components, reflect the accommodation of different interests as well as the cooperative nature of the working relationship between its members. All decision making authority flows from the Board of Directors which is composed of a senior officer, usually the Chief Executive Officer, from each member company. It determines policies, provides overall direction, and ensures that member company interests and concerns are reflected in Telecom Canada decisions and actions. The Network Development and Operations Department has the responsibility for Network Planning in Telecom Canada.

5.2 THE NETWORK PLANNING PROCESS

The scope of centralized Network Planning is wide and complex, covering audio, image, text and video, both nationally and internationally, and involves the overseeing of all network sectors - switching, transmission, control, intelligence, interworking, access administration, standards and operations. The planning also spans the near (next 2 years), medium (2-5 years), and long term (year 2000+) time horizons, making it a very comprehensive process.

The logical starting point for the network planning process is Network Evolution Planning (NEP), which develops and evaluates possible and probable network evolution paths from the near term to well into the next century. It is developed by sifting through futuristic studies and predictions, compiling and summarizing the opinion of a hundred or so experts within the member companies, and through well formulated research.

NEP produces one or more scenarios of the capabilities that Telecom Canada Networks could possess by specified times in the future. These images of future networks and technologies give strategists meaningful options to choose from.

Such long range conceptual views of the network are important for a number of reasons: Modern telecommunications networks have become so complex that it is no longer possible for any one person to be totally knowledgeable about it, and these scenarios synthesize, using the collective expertise of the member companies, the information necessary for strategic decisions; technology capabilities for the medium to long term future require substantial commitments now, and mistakes can be costly, implying that decisions about the future must be made with as much awareness as possible; it gives planners a sense of the place of their plans in the overall scheme of things. The development process of these scenarios ensure that views and considerations internal and external to Telecom Canada are accounted for.

NEP thus forms an essential backdrop for the development of the Network Strategic Plan, which in turn provides Strategic Thrusts that drive the Fundamental, Current, and Technical Planning activities in Telecom Canada. These planning activities generate implementable Projects, Plans, and Technical Guides. For example, the Fundamental Planning group, taking its cue from the Strategic Thrusts, directs engineering and economic feasibility studies pertaining to new service offerings, and develops network architectures to deliver the services. These plans are then executed by implementation primes. (Figure 3)

NETWORK PLANNING PROCESS

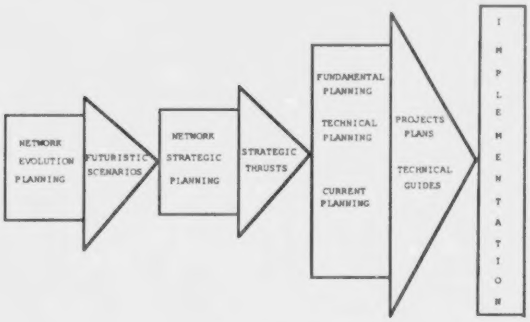

FIGURE 3

5.3 THE NEED FOR STRATEGIC PLANNING

Over the years, the quality of Canadian Telecommunications has achieved a pre-eminent position in the world. The network is technically advanced, well managed, and the services are affordable. However, new business and economic realities, changes to the telecommunications market structure, technological innovations, public opinion and priorities, cost structure, regulation, and competition have necessitated a refocusing of Telecom Canada's activities and endeavors.

Driven by the increasing globalization of business and intensifying competition, communication needs for business are changing rapidly. Increasingly sophisticated and knowledgeable customers look for communications capabilities to provide strategic and competitive advantages. Technological advances hold the promise of being able to deliver tremendous capacities and functionality. However, the realization of these opportunities will be costly, requiring significant effort to overcome the complexities of developing systems and services, and of the integration with existing structures and systems. For Telecom Canada these are not insurmountable challenges. However, these challenges are being compounded by profound changes to the communications market structure itself, as it is being reshaped by regulation and by increasing competition; the telecommunications industry is truly becoming part of the free market.

5.4 INITIATION OF STRATEGIC PLANNING

The need for Strategic Planning in Telecom Canada was recognized at the highest levels and decisions were made by the Board of Directors to develop a Network Strategic Plan (NSP), and a Strategic Marketing Plan as synergistic and coordinated components of overall Strategic Planning in Telecom Canada.

Two measures ensured the acceptance of the Strategic Plans by all member companies, and a commitment to its implementation. The first was the involvement of every member company in the Strategic Planning process. This was accomplished through two working groups - the Network Strategic Planning Group (NSPG), and the Senior Marketing Advisory Group. These working groups were chaired by Central Staff, and had senior representation from all member companies. They were mandated to produce the Network Strategic Plan and the Strategic Market Plan respectively. The NSPG was given the directive to produce a strategic plan which would define the network development and operations direction for the next decade, viewing the network as a customer to customer entity, and ensuring that the network strategies were aligned with the marketing strategic initiatives.

To gain further commitment to its implementation, the Network Strategic planning process was designed to fit seamlessly into the already existing Network Planning process (see Figure 3).

5.5 FORMAT

The experience of other corporations in North America indicate that the format for developing a strategic plan is as important as the plan itself. The format must reinforce a total corporate acceptance of, and commitment to, the plan. It must also generate a sense of personal ownership.

Telecom Canada prefers a workshop development format in which the strategic planning working group meets to discuss, at every stage of the strategic planning process, issues that need resolution and that are vital to the completion of the plan. The workshop sessions are structured to allow full and free dialogue and arrive at consensus and closure on every issue, within a prescribed time.

6. THE NETWORK STRATEGIC PLAN - DEVELOPMENT

6.1 THE MISSION STATEMENT

To develop the Network Strategic Plan, the NSPG carried out intensive workshop and work exercises for a period of about four months.

The action that served as a kick-off for the development of the NSP was the development of the NETWORK MISSION in support of the overall Telecom Canada mission. The Telecom Canada Network Mission Statements was produced by the NSPG, and hence, has the endorsement of the individual member companies.

In initial sessions the group familiarized itself with the task at hand by exploring the need for a Strategic Plan and identifying issues that it would have to addressed. The group concluded that responding to pressures from global competition, Canadian industries will demand the very best in telecommunications, and that their expectations will be high.

6.2 NETWORK GOALS

In support of the Mission, Network Goals were established in the areas of responsiveness to customer needs; quality of service; technology leadership; and cost effectiveness.

Measures of success were also established. For example success in responsiveness could be determined by objective customer surveys.

6.3 NETWORK BUSINESS DIRECTION AND VISION

This business direction is defined in terms of portfolios for each major market segment. The market segments used were:

- residence
- small business
- medium to large business
- public
- international

Where appropriate, network technology implications were identified for each service/segment.

The Business Vision is not a blue print for network evolution. However, it is a major input into the strategic plan as it permits a broad picture of the types of business and services the network will be required to support within the next five to ten years.

6.4 ENVIRONMENTAL ANALYSIS

The most certain trend for the future is a rapidly changing environment. A number of factors contribute to this change.

6.4.1 CHANGES IN THE ECONOMY

In the economic environment, business will continue to become increasingly global. Economic growth will dominate the service sector, making this sector one of the most important components of the global economy.

6.4.2 SOCIETAL CHANGES

Accelerating societal changes, with knowledge workers assuming the majority position in the workplace is foreseen. Entertainment led stimulation in the development and implementation of electronic entertainment, as well as other information needs, will increase reliance on telecommunications networks.

6.4.3 TELECOMMUNICATION NEEDS

The accelerating need for telecommunications is a driver in the development of innovative new services needing greater and greater bandwidths. Technical complexity is seen to make turnkey solutions more attractive, while the development of connectivity may accelerate. The nature of the evolving telecommunications infrastructure will place high demands on the reliability and survivability of telecommunications services.

6.4.4 EMERGING TECHNOLOGIES

Evolving technologies are expected to have a greater impact on the telecommunications industry. New technologies can open new markets and provide the capabilities for new services. At the same time, new technologies may threaten to make existing networks obsolete, or inappropriate. Optical systems, and opto-electronic technologies are generally expected to show rapid technological progress. CAD/CAM applications will become increasingly embedded in the design of manufacturing processes, with greater integration of system functions. Speech synthesis/recognition is expected to become more realistically possible, with resulting implications for man/machine interface simplification. Increasing focus on OSI standards will facilitate the interconnection of diverse information systems, accelerating the usefulness of telecommunications to link such systems. ISDN standards, initially narrow-band, later broadband, could aid in establishing the ubiquitous connectivity of voice, data, and image systems.

Multi-fabric switching will incorporate hardware and software technologies. Network elements will become increasingly intelligent, and the logical architectures that will be mapped onto the physical architectures will become increasingly complex.

6.4.5 PUBLIC POLICIES AND REGULATION

The regulatory situation may become more complex with new players and more sophisticated technologies and services.

6.5 SITUATION ASSESSMENT

The Situation Assessment represents an important and sensitive part of the Network Strategic Plan. It identifies strengths which can be capitalized on, and opportunities which can be exploited, to overcome weaknesses and counteract threats in order to provide a competitive edge and maintain a position of leadership.

Some considerations in assessing threats and opportunities were:

- Competition
- Terminal Equipment
- Regulation and Government Policy
- Technology
- Standards
- Services
- OA&M deployment, etc.

Some considerations in assessing strengths and weaknesses might be:

- Network Ubiquity
- Industry Leadership
- People
- Organization
- Network Technology and Architecture, etc

6.6 STRATEGIC THRUSTS

6.6.1 GENERAL

Consistent with the Network Mission and Goals, recognizing the changing environment, and in response to the Situation Assessment, a set of specific Strategic Thrusts were developed. The Strategic Thrusts were formulated based on a Vision of the Network that included all components from customer to customer, comprising Access, Switching and Transport (identified as Core), Intelligence, and associated Operations, Administration and Maintenance (OA&M) Systems.

Due to their sensitive nature, strategies specific to Telecom Canada will not be discussed. This section will only identify the types of considerations appropriate for the development of strategies.

6.6.2 ACCESS

Evolution of the Access Network to a fibre based architecture that can carry narrowband services and provide Broadband capability is a consideration in a modern network. Wireless access capability should also be a consideration.

6.6.3 CORE

In Switching and routing, consideration should be given to evolution which will allow more efficient use of trunk capabilities and adapt more quickly to shifts in the distribution of traffic. It also improves network survivability in the event of transmission or switching equipment failure. Evolution of digital switches to broadband and integrated switches, replacing circuit and packet switches, should be an additional consideration.

SONET is a consideration for augmenting network transport capacity and survivability.

6.6.4 NETWORK INTELLIGENCE

The deployment of enhanced Network Intelligence is another area that should receive attention. Network intelligence is implemented in the form of software and is used to provide service features and operational functions in the network. The most effective placement of this intelligence, in the network versus the terminal, needs to be addressed.

Present services using database located network intelligence are 800 service and Automated Card Calling Service (ACCS), centralized databases provide the screening and routing (number translation) functions. In the case of ACCS, the databases allow verification of the calling card number. A service support system allows the information in the databases to be updated.

In most current networks, intelligence resides in the switching entities and provides such services as Centrex and Custom Calling features. To expedite service provisioning, the industry is developing a standard modular call processing software environment that would allow telecommunication companies to create services quickly and provide customers with increased programmability and control.

6.6.5 OA&M

Operations, Administration and Maintenance (OA&M) systems need consideration. Properly planned and integrated OA&M systems will allow the operation and maintenance of the network, and also meet end-to-end customer needs.

6.6.6 PROCESS AND ORGANIZATION

In addition to the technology oriented strategies, due consideration should be given to the organizational, cultural, and management processes, to reflect a competitive, market-driven environment. Recognition should also be given to developing means to focus R&D and Standards activities in support of identified Strategies.

7. TRACKING

The development of a strategic plan is not an end in itself; its implementation must be ensured.

The Network Development and Operations department in Telecom Canada has instituted procedures for monitoring and regularly reporting to higher management and to the Board of Directors the status of implementation of strategies. This is a very important part of strategic planning and must not be by-passed on any account.

Tracked results in Telecom Canada show evidence of a tighter link between goals, strategies, and action plans.

8. EPILOGUE

8.1 HAS STRATEGIC PLANNING BENEFITED TELECOM CANADA?

As was noted earlier, Strategic Planning is more than a one-time activity, it is also a reshaping of the corporate culture. The Strategic Planning in Telecom Canada has created a general sense of purpose and commitment to the corporate mission and goals. Proposals for new medium term Programs, Projects and R&D, are driven by Strategic Thrusts as are prioritization of planning activities. Management at all levels are able to, and do, question the relevance of actions and decisions, and assess critical resource requirements objectively in the light of articulated common aims.

Strategic Planning principles have been well accepted, and, using these principles, planning groups at different management levels have developed their own strategic plans to further the corporate missions and goals. At the same time a corporate strategic focus has been the chief driving force for major departmental and corporate organizational changes to improve functional efficiency and corporate effectiveness.

Strategic Planning has become a part of the Telecom Canada organizational culture.

REFERENCES

(1) Ackoff, Russell L., "A Concept of Corporate Planning", John Wiley & Sons, New York, 1970.

(2) Meredith, Mark; Robert G.Cope; Oscar Lenning; "Differentiating Bona Fide Strategic Planning from Other Planning." Technical Paper, Boulder, Colorado: University of Colorado. ED 287 329, as quoted in (3).

(3) Cope, Robert G., "Opportunity from Strength. Strategic Planning Clarified", Futures Research Quarterly, Summer 1989.

BIBLIOGRAPHY

1. Cleland, David I. and William R.King, "Strategic Planning and Policy", Van Norstrand Reinhold Company, 1978.

2. Drucker, Peter, "Innovation and Entrepreneurship: Practice and Principles", Fitzhenry and Whitesnake, Toronto, 1985.

3. Joseph, Jacob R. (ed), "Proceedings of an International Symposium on Communications Technology and International Development: Issues and Perspectives", Ottawa University, Institute for International Development & Co-operation, 1986.

4. Peter, Tom and R. Waterman, "In Search of Excellence: Lessons from America's Best Run Companies", Harper and Row, New York, 1982.

5. Wenner, David L., "Are LEC Executives Skillful Enough to Compete?" Telephony, October 8, 1990.

The State Role in Rural Telecommunications Policy: Setting the Stage for Rural Participation in the Global Economy

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ABSTRACT

This paper reports on results of research into the relationship of U.S. state regulation of telecommunications infrastructure with rural economic development. The study includes a 50 state survey of state telecommunications regulatory commissions plus interviews with officials of other state agencies concerning how telecommunications goals and policies are formulated at the state level and what approaches states have taken to integrate telecommunications and rural development planning and policies. The paper then identifies policy goals and recommendations to relate state telecommunications and rural development goals and strategies more closely. The research was funded by the Ford Foundation with support from the Aspen Institute.

1. Introduction

The economic gap between rural and urban America was one of the major themes of Rural America in the Information Age. (Parker, Hudson, Dillman and Roscoe, 1989) Telecommunications and information technologies can help the rural economy to become more competitive and provide access to a range of educational and social services previously available only in cities. Yet there is another chasm that must be bridged. The fields of telecommunications and rural development have been considered two different worlds with virtually nothing in common. We need to bridge the gap between these fields if we are to harness new technologies to overcome the barriers of distance.

The purpose of the second phase of the Rural America study is to examine how telecommunications goals and policies are formulated at the state level and what approaches states have taken to integrate telecommunications and rural development planning and policies. Information was gathered from a questionnaire administered to Public Utilities Commissions in all 50 states, supplemented by interviews with legislative and development agency officials. The study then identifies policy goals and recommendations to relate state telecommunications and rural development goals and strategies more closely.

2. Telephone Companies Serving Rural Areas

There is great variation in the number and size of telephone companies serving the different states.

Small Rural Telephone Companies: The number of small rural telephone companies providing service in the states varies widely from 0 (e.g. Delaware, Hawaii) to more than 90 (Iowa, Minnesota, Wisconsin). States with more than 30 small rural telephone companies are located primarily in the west and south.

TABLE 1: SMALL [illegible]EPHONE COMPANIES SERVING RURAL AREAS

Number of Small Telcos	Number of States
0 - 10	8
11 - 20	10
21 - 50	24
51 - 100	3
over 100	1
(no response	1)

Major Independent Telephone Companies: The number of major independent telephone companies serving rural areas ranges from 0 to 7. States with 5 or more major independents serving rural areas include Maine, Illinois, Wisconsin, Pennsylvania, Ohio, and Georgia.

Bell Operating Companies: Bell Operating Companies typically serve both rural and urban areas in each state. There is no Bell Operating Company presence in Alaska or Hawaii.

Interexchange Carriers: Interexchange carriers generally terminate calls throughout rural as well as urban areas. However, rural customers are much less likely than urban customers to be able to choose among carriers to originate their calls. As noted above, PUCs are generally unable to provide accurate data on interexchange carriers that originate traffic in rural areas. They also generally do not have data on long distance resellers, although these carriers operate primarily in urban markets.

AT&T serves as the carrier of last resort for interLATA traffic. Data were obtained from one major interexchange competitor. These data show that the carrier offers originating service to more than 1200 local exchange carriers, most of which have from a few hundred to a few thousand access lines. However, many rural areas do not yet have 1+ access to more than one long distance carrier.

3. The Role of the PUC

3.1. PUC expertise

There is a wide range in the number of professional staff from state to state. As would be expected, the states with the highest populations have the most staff. Six states have more than 300 staff (California, Illinois, New York, New Jersey, Ohio, Pennsylvania), while 10 states report having 20 or fewer total professional employees (Delaware, Hawaii, Louisiana, Montana, Nebraska, North Carolina, North Dakota, South Dakota, Utah, Wyoming).

TABLE 2: TOTAL NUMBER OF PROFESSIONAL STAFF IN PUCS

Number of Staff	Number of States
0 - 20	10
21 - 50	12
51 - 100	12
101 - 200	5
201 - 500	10
over 500	1

However, the number of staff that deal with telecommunications is in most cases a small fraction of the total professional staff. Only New York and California have more than 50 professional staff working exclusively with telecommunications. Twenty-seven states have ten or fewer staff working exclusively working on telecommunications; five states have no staff assigned exclusively to telecommunications.

TABLE 3: PROFESSIONAL STAFF WORKING EXCLUSIVELY ON TELECOMMUNICATIONS

Number of Staff	Number of States
0	5
1 - 5	17
6 - 10	10
11 - 20	8
21 - 50	8
over 50	2

It should be noted, however, that some commissions do not dedicate professional staff exclusively to telecommunications, but assign engineers and economists who cover all utilities they regulate. Some states such as California rotate professional staff through various divisions so that they become familiar with all of the utilities under their jurisdiction.

3.2. PUC: Regulation vs. Policy-Making

PUCs were established to regulate utilities in their states. In theory, policy-making is to be done by the legislature, with the PUCs simply enforcing policies that have been legislated. However, by changing regulations and implementing new regulations that affect pricing, quality of service and investments, the PUCs do in fact make policy.

PUCs were asked whether they considered their role exclusively regulatory, primarily regulatory, or both regulatory and policy making. The vast majority (62.5 percent) saw their role as both regulatory and policy making. Another 33.9 percent saw their role as primarily regulatory, but also involved in making policy. None saw themselves as exclusively regulatory (although one telephone association characterized its state PUC that way).

The PUCs were asked to describe the approach of their Commission as strictly reactive (responding to issues raised by carriers or other agencies); somewhat proactive (sometimes initiating hearings or investigations); or strongly proactive (initiating hearings, proposing legislation, etc. to deal with future issues or problems that have not been raised by the carriers).

Eighty percent of commissions considered themselves strongly proactive, while eighteen percent considered themselves somewhat proactive. Only one commission considered itself strictly reactive. While not unexpected, the results are interesting in that they show that the commissions see themselves as state policy makers in telecommunications. However, as we will see below, they do not generally have very clear guidelines about how to develop policies to support economic development.

It is also worth noting that the telephone associations generally agreed with the characterizations the commissions used to describe themselves. Only two associations disagreed (one characterized its commission as "somewhat" rather than "strongly" proactive, and the second labeled its commission "reactive" rather than "somewhat proactive").

3.3. Criteria Used in Making Regulatory Decisions

Virtually all of the commissions stated that they take into consideration the impact on the telecommunications industry, the impact on consumers, and impact on the state's social and economic development in making regulatory decisions. However, very few were able to explain how they measure impact on social and economic development.

Criteria used to assess impact on the industry were expressed as financial soundness of the utility, impact on company earnings, opportunity to earn a reasonable rate of return. Some added more specific concerns such as:

. ensuring financial viability of small telephone companies
. fostering of competition (also evaluating and promoting or discouraging competition as appropriate)
. discouraging uneconomic bypass
. sharing of costs between local exchange carriers,
. practicability of proposed changes.

Some commissions appeared to limit their socio-economic analysis to consumer issues, citing rates as their primary consideration, particularly for residential consumers. Criteria used to judge impact on consumers are overwhelmingly rates and quality of service. While many states said that they also considered impact on the state's social or economic development, most did not cite any specific criteria for assessing these impacts. The states that did respond noted the following indicators:

. promoting efficient use of facilities
. enhancement of state network
. infrastructure support for state economy
. impact on attracting and retaining industry
. rural access to same services available in urban areas.

Sources of expertise cited for these development issues were state government economic development staff, PUC staff such as the public advocate, expert witnesses, and/or special impact studies. Despite the lack of goals and criteria, some PUCs noted that impact on development was considered a secondary issue but increasing in importance, and one state said it was currently a hotly contested issue.

3.4. Importance of Decisions Made in Other States

The commissions were asked to state the importance to them of decisions and policies made by other regulatory commissions, both across the country and in their region. Most stated that the activities of other commissions across the country were somewhat important. A few stated that decisions made elsewhere were very important; they tended to be looking for bellwether policies to study or emulate. States that found commission decisions across the country very important were California, Colorado, Maine, Michigan, Montana, Oregon, and Tennessee.

A few PUCs said that decisions made across the country were not important to them, primarily because they felt conditions in their state were unique, or at least atypical: e.g. Alabama, Florida, Indiana, Nevada, and New Mexico.

More commissions thought that decisions and policies made by other commissions in their region were very important. About 17.5 percent of respondents thought regional decisions were very important, while 77.5 percent thought they were somewhat important. Only 5 percent thought they were not important. Typically, they commented that it was necessary to share information with other states served by the same regional Bell operating company (RBOC).

4. State Government Involvement in Telecommunications

Although most commissions now see their role as policy-making as well as regulatory, they are clearly not the only entities responsible for making policies in their state. The legislature may enact laws affecting telecommunications, and the executive branch may also play a role in formulating government policy. Various state government agencies may also be involved in state telecommunications planning and policy.

4.1. Executive

Governor's Office: Twenty-one states said that the governor's office played a role in telecommunications policy. However, these roles vary considerably, and are often indirect or temporary rather than functional responsibilities. The governor directly influences telecommunications policy in many states through appointing PUC commissioners. Governors may also get involved by establishing taskforces on telecommunications (e.g. Missouri) or participating in telecommunications taskforces of the National Governors Association (e.g. Maine, Colorado).

Some states assign telecommunications matters to more general functional divisions of the governor's office such as an office of plans and policy or office of information and technology.

State Government Agencies: Respondents identified an additional 90 state agencies that are involved in telecommunications policy and planning. These agencies fell generally under the following categories:

. administration or general services
. emergency services
. state planning
. consumer affairs
. commerce or economic development
. education.

A majority of agencies named (53 percent) plan telecommunications facilities for state use. Other common functions include reviewing telecommunications plans from other agencies (32 percent) and coordinating with the PUC (27 percent).

The PUC respondents thought that only 3 percent of the state agencies they identified considered regional development in their telecommunications planning. It should be noted that this percentage probably underestimates the number of state agencies somehow involved with telecommunications planning. For example, as noted below, many state education agencies are supporting projects using telecommunications for distance education. And development agencies (such as economic development or commerce) identified through other sources typically do consider regional development goals. But two factors should be noted about these agencies:

. they typically do not have a mandate to do telecommunications planning or activities, and are generally involved on an ad hoc project basis;

. regardless of their mandate, they are not perceived by the PUCs as having any ongoing role in state telecommunications planning or policy.

4.2. Legislature

Legislative Committees: None of the states have legislative committees that deal exclusively with telecommunications. Typically, telecommunications is linked with other utilities such as electricity, water, and natural gas; transportation; and/or commerce. While telecommunications is often considered under the rubric of "infrastructure" with, for example, electricity and roads, there does not seem to be much recognition of the interrelatedness or complementary contribution of these elements to state development. Even where telecommunications is clustered with commerce or economic development at the committee level, the two areas are often considered separately, apparently without recognition of the relationship of telecommunications investment to economic development.

Legislative expertise: Legislative expertise in telecommunications is often extremely limited. Some 27 states reported that there were no professional staff working on telecommunications. Most of the rest had one or two; no state reported more than six.

Many reported that the legislature relies on the PUC staff for expertise. Other sources of expertise cited are other state government staff (state telecommunications administrators, public counsel, etc.), consultants, consumer representatives and telephone company lobbyists. The latter category was mentioned by 42 percent of the respondents, and appears to be a source of expertise for legislatures in many other states as well.

Rural Development Committees: In some states, legislative committees responsible for economic development, regional development, or rural development do participate in state telecommunications planning or policy. They include: Alabama, Arizona, California, Florida, Georgia, Indiana, Kentucky, Michigan, Nevada, New Jersey, New Mexico, South Dakota, Virginia, Washington, Wisconsin, Wyoming.

5. Rural Telecommunications Decisions and Projects

5.1. Regulatory Decisions: Forty-one commissions stated that they had made decisions in the past three years that affect access to telecommunications services in rural areas, cost of rural services, and/or quality of rural services. This response is particularly interesting in light of the reported general lack of formal consideration of rural development in telecommunications policy noted above.

These decisions included requirements for upgrading rural facilities, eliminating multi-party service, reducing costs of rural services through general rate reductions, extended area service rates, lifeline and link-up programs, etc.

5.2. Project Initiation

Survey respondents were asked to provide information on rural telecommunications projects in their states implemented in the last two years or currently being implemented or planned. For each, they were asked to state what entity initiated the project and who provided the funding.

Initiatives for these projects have come from a number of sources. Some are the result of government commitments to improve services or reduce rates to rural communities. In other cases, public pressure has resulted in extension of services or rate reductions. However, often the telephone companies themselves have been initiators. Small companies may see new services as a means of increasing use of their networks. Larger companies may propose upgrades of rural facilities as a "good citizen" commitment in return for concessions on regulation or rates. They may also implement pilot projects as test and demonstration activities for new services, such as broadband educational networks.

TABLE 4: INITIATION OF RURAL TELECOM PROJECTS REPORTED BY PUCS

Project Initiator	Percent of Projects
telephone company	56.2 %
government agency	37.1 %
consumers	6.7 %

(N = 89 projects)

Respondents reported that a few projects were initiated by more than one entity, typically phone companies and government.

5.3. Project Funding

A number of approaches are used to fund these projects. The most common source of funding of the projects reported was the telephone company through normal capital sources (51 percent). Twenty-five percent were funded by telephone companies with REA funds and 11 percent by telephone companies through special initiatives. Seventeen percent were funded through more than one source.

Projects funded through other sources such as state and local initiatives and customers totaled only 30 percent of the projects reported. Again, this estimate is likely to reflect the perspectives of the telecommunications sector (regulators and telephone associations) which may not be aware of other telecommunications projects in their states.

Funding by telephone companies is accomplished in several ways, usually requiring the approval of the PUC. For example, accelerated depreciation may be adopted to encourage early replacement of obsolete equipment. Surcharges may be authorized to pay for uneconomical services. Cross-subsidies may be used to allow more profitable services to subsidize loss-making services. Telephone companies may also be ordered to invest surplus revenues in upgrading facilities.

These approaches of using rates and incentives are more prevalent than government funding for new or improved services. However, small phone companies may apply for REA loans to upgrade facilities. State governments may also fund rural projects either through direct investment in facilities or through leasing capacity from telephone companies to offer educational and other services.

It should be noted that the regulatory commission generally plays a role in these projects, whether or not it was an initiator. For example, the commission must approve a deregulatory plan that gives the telephone companies more pricing flexibility in return for accelerated upgrades of rural services. The commission must also approve funding methods such as surcharges, cross subsidies, or accelerated depreciation. Commissions may also need to approve special capital initiatives such as upgrading outside plant and installing optical fiber for pilot projects.

6. Recommendations: Bridging the Gap between Telecommunications and Regional Development

6.1. Innovative Models:

Despite the limitations, there are many examples of innovation that may serve as models for more effective coordination of state telecommunications and regional development plans and strategies:

. Task forces and commissions in several states have brought together representatives of state government agencies, telephone companies, business, and consumers to examine how new technologies can be introduced to meet the states' changing needs.

. Pilot projects, particularly in education, have introduced new applications of telecommunications and information technologies for rural development.

. Telephone companies have banded together to aggregate customer demand in order to offer services such as equal access to interexchange carriers to rural customers.

. Information-intensive jobs such as directory assistance and telemarketing have been relocated to rural areas.

. State regulators have used post-divestiture pressures to find alternatives to rate of return regulation, and created incentives for telephone companies to increase investment in rural facilities.

. The social contract model has been developed to bring together all of the interested parties including state government, the carriers, business and residential users, in order to develop goals and work out strategies to make high quality but affordable telecommunications services universally available.

6.2. Goals and Recommendations

There are some serious gaps between telecommunications and rural development planning and policy at the state level. In most states, telecommunications and regional development planning are totally functionally unrelated. Indeed, there may be no telecommunications planning beyond the internal needs of the state government. The roots of the problem appear to lack of awareness of the role of telecommunications in regional development and lack of mechanisms for coordination among state agencies and between them and the telecommunications industry and consumers.

The following goals and recommendations are designed to address the need for more direct and coordinated participation by state agencies in rural telecommunications planning and policy. They are part of a larger set of policy goals and recommendations covering a full range of rural telecommunications issues that will be included in the final version of the report on rural telecommunications at the state level.

Policy Goal 1: Coordinate Telecommunications and Economic Development

Recommendation 1.1: State regulatory commissions and state economic development agencies should establish a formal mechanism to coordinate their policies and programs to achieve state economic development goals.

Recommendation 1.2: State regulatory commissions should conduct hearings in both urban and rural locations to identify development needs as part of their process of establishing telecommunications policies in support of development goals.

Policy Goal 2: Increase statewide awareness and understanding of telecommunications and development issues and opportunities

Recommendation 2.1: Development agencies should hold regional workshops to gather and to share information about innovative uses of telecommunications and about the role of telecommunications in development generally.

Recommendation 2.2: Development agencies should sponsor a state ad hoc task force to prepare a set of specific goals and plans for the implementation and use of modernized telecommunications networks and services that could further the state's general development goals.

Recommendation 2.3: Development agencies should prepare and distribute an inventory of the telecommunications infrastructure and services in their state.

Policy Goal 3: Advocate effectively telecommunications policies that serve the goals of economic development

Recommendation 3.1: State development agencies should assign a staff person to manage a program of advocacy for economic development interests.

Policy Goal 4: Foster better understanding by small businesses and rural communities of how they can use the available telecommunications services

Recommendation 4.1: State development agencies should build a telecommunication component into small business assistance programs.

Recommendation 4.2: Development agencies should arrange for a training course or program on telecommunications for community and economic development professionals.

Policy Goal 5: Provide adequate training to prepare the rural workforce to meet the telecommunications needs and opportunities of business

Recommendation 5.1: Development agencies should work with community colleges to establish telecommunications training courses.

Recommendation 5.2: State development agencies should encourage and support the establishment and expansion of distance learning programs.

Policy Goal 6: Aggregate together the rural and small business demand for modern telecommunications services

Recommendation 6.1: Development agencies should work with rural communities and small businesses to help them to obtain collectively the telecommunications services they might not be able to obtain individually.

In addition, telephone companies themselves must get more involved, not only in upgrading their facilities, but in working with rural agencies and businesses to implement projects that will help rural areas to obtain maximum benefits from telecommunications investments.

REFERENCES

Arnheim, Louise. "Telecommunications Infrastructure and Economic Development in the Northeast-Midwest Region." Washington, D.C.: Northeast-Midwest Institute, April 1988.

Beamon, Clarice. "Telecommunications: A Vital Link for Rural Business." OPASTCO Roundtable, spring 1990.

Bryant, John. House of Representatives Congressional Record, August 3, 1990.

Chugach Conference Proceedings. Anchorage: University of Alaska, August 1989.

Cleveland, Harlan. "The Twilight of Hierarchy: Speculations on the Global Information Society." Public Administration Review, 45:185, 1985.

Coulter, Kristin. "The Telco in Rural Development." OPASTCO Roundtable, spring 1990.

Depo, Gerald E. "Telecommunication Concept for the Town of Bloomsburg." Bloomsburg, PA, 1990.

Digital Information Group, Stamford, CT. Information Industry Factbook, 1989/90 edition, and Information Industry Bulletin, August 9, 1990.

Dillman, Don A. Personal communication. Washington State University, Pullman, WA, 1990.

Dillman, Don A. and Donald M. Beck. "Information Technologies and Rural Development in the 1990s." Journal of State Government, Vol. 61, No. 1, January/February 1988.

Estabrooks, Maurice F. and Rodolphe H. Lamarche, eds. Telecommunications: A Strategic Perspective on Regional, Economic and Business Development. Moncton, NB: Canadian Institute for Research on Regional Development, 1987.

Fund for Rural Economic Development. "FRED Facts." Washington, D.C., OPASTCO, 1990.

Hardy, Andrew P. "The Role of the Telephone in Economic Development." Telecommunications Policy, December 1980.

Harris, Robert. "The Regional SS7 Network: An Intelligent Application for Rural Telcos." Rural Telecommunications, summer 1989.

Hudson, Heather E. When Telephones Reach the Village: The Role of Telecommunications in Rural Development. Norwood, NJ: Ablex, 1984.

Lawton, Raymond A. Telecommunications Modernization: Issues and Approaches for Regulators. National Regulatory Research Institute, Columbus OH, 1990.

Lehner, J. Christopher. "Rural Development at a Crossroads: The Emergence of a National Consensus." Rural Telecommunications, Fall 1989.

---------------------. "Toward Rural Revival: The Telco-Community Partnership." Rural Telecommunications, summer 1990.

--------------------- and Ingrid K. Young. "Conspicuous Personalities: Ideas from Rural Telephony." Rural Telecommunications, winter 1989.

Lloyd, Ann. "The Rural (Radio) Connection." Rural Telecommunications, fall 1988.

Manto, Charles. Economic Development Corporation of the County of Marquette, Michigan. Personal communication, 1990.

National Telecommunications and Information Administration, Telecom 2000: Charting the Course for a New Century. NTIA Special Publication 88-21. Washington, D.C.: Government Printing Office, October 1988.

Noam, Eli M. Questions by Commissioner Eli M. Noam concerning the establishment of economic incentives for quality performance by New York Telephone, as part of the general treatment of its rates. New York Public Service Commission, Case 28961, Fifth Stage, undated (circa 1989).

Noam, Eli. Personal communication, 1989.

OPASTCO. Washington Weekly Report, August 13, 1990.

Parker, Edwin B., Heather E. Hudson, Don A. Dillman, Andrew D. Roscoe. Rural America in the Information Age: Telecommunications Policy for Rural Development. Lanham, MD: University Press of America, 1989.

Public Utility Commission of Texas. "Dockets 8585 and 8218: Stipulation and Agreement." February 2, 1990.

Pulver, Glen C. "The Changing Economic Scene in Rural America." Journal of State Government, Vol. 61, No. 1, January/February 1988.

Roberts, Brandon. States: Catalysts for Development in Rural America. Washington, D.C.: Council of State Community Affairs Agency, 1990.

Rudd, David. "Regulating the BT Giant: Consultation Without Information," Telecommunications Policy, Vol. 12, No. 4, December 1988, pp. 318-322.

Rude, Suzanne D. "Developments in State Telecommunications Regulation: Experience in Vermont." Paper presented at the Seventeenth Annual Telecommunications Research Conference, Airlie, VA, October 1989.

Salant, Priscilla. A Community Researcher's Guide to Rural Data. Washington, D.C.: Island Press, 1990.

Schmandt, Jurgen, Frederick Williams and Robert H. Wilson. Telecommunications Policy and Economic Development: The New State Role. University of Texas at Austin, 1988.

Silkman, Richard. Personal communication, 1989.

Silkman, Richard. Personal communication. State Planning Office, Augusta, ME, 1990.

State Telephone Regulation Report, Telecom Publishing Group, Alexandria, VA, August 24, 1989.

State Telephone Regulation Report. Telecom Publishing Group, Volume 8, Number 20, Alexandria, VA, October 18, 1990.

Wall Street Journal. "Analog Switches Get a Chance to Go Digital." November 1, 1990, page B1.

Williams, Frederick. "States Step Up to the Challenge." Telephony, October 16, 1989.

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WIDE AREA NETWORK CONSTRUCTED WITH FACSIMILE MAIL SYSTEM

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ABSTRACT

Facsimile is an important communication method for business. A facsimile mail system (FMS) has been introduced and facsimile machines continue to increase in popularity. The FMS is an effective tool to improve communication services. Large-scale networks are designed by distributing and linking FMSs.

In this paper, we outline problems on using the FMS to design a wide area network and Fujitsu's FMS "Hyper Media Communication Processor" (HMCP), and the show application examples.

1. INTRODUCTION

In Japan, the G3 facsimile has become widely accepted as a method of communication for business and the home. The G4 facsimile will soon become popular due to the INS net service introduced by Nippon Telegraph and Telephone Company (NTT) as a public ISDN service.

Facsimile transmission has become an important communication method. The FMS is becoming popular because of its advanced features such as storing facsimile data temporarily and printing or sending it later.

Figure 1 shows the facsimile mail principle.

The FMS is accessed from the transmission facsimile machine and a message is input together with the service menu and destination address. The message is temporarily stored in the mail box.
Communication is then done according to the service menu and destination address.

Popular communication service are beroadcast communication, time-appointed transmission, express delivery, confidential communication, and notice boards.

This principle is basically the same as that of G3 and G4 facsimile. The only difference is in the communication protocol between the facsimile machine and FMS.

2. Facsimile Mail System (FMS) SERVICE AND EFFECT

2.1 System Configuration

The FMS is connected to a switching network (telephone network or ISDN) and accessed as required from a facsimile terminal connected to the telephone network or ISDN.

This cofiguration is used because the FMS adds value to facsimile communication.

When more than one FMS is used by an organization, data can be transmitted efficiently when the FMSs are connected using leased lines under a high-level protocol. Communication cost can be reduced largely when public telephone networks and leased lines are connected via FMSs (public-leased-public connection) as shown in Figure 2.

2.2 Mail Service and Effect

(1) Broadcast communication service

A transmitter can transmit a message to more than a single destination with only one transmission operation when this service is used. The FMS retransmits the message automatically if a destination line is busy or facsimile forms are exhausted.

Destination address can be individually specified, but destination address accessed often are simply specified using the list.

The sequential broadcast method depending on the number of FMS accommodated lines is used. The broadcast time can be calculated using the following expression:

Broadcast time
= number of destinations × communication time
/ number of lines simultaneously processed

Facsimile transmission time can be greatly reduced when this service is used.

(2) Time-appointed transmission service

Distribution time is previously specified and distribution starts at the specified time.

Line cost can be reduced when messages with lower priority are sent during discount periods at night. In addition, the load of the reception terminals can be distributed during the busiest period.

(3) Confidential communication service

Facsimile communication normally uses automatic reception. However, if a confidential message is transmitted, forms are not output at the destination immediately. When this service is specified, a message input to the FMS is stopped in the FMS mail box.

The message can be printed out using a password. The message is thus kept secure.

(4) Notice board service

Messages registered in the FMS as notice board information can be fetched by anyone. The FMS notice board information cannot be checked directly from the terminal when compared to the electronic mail notice board. Therefore, notice board numbers are generally reported to the end users befriend.

(5) Destination name attachment service

Destination address, positions, and names are registered in the FMS in a way that makes the address correspond to the positions and names. When a destination address is specified, the FMS recogniz the corresponding destination name and attaches it to the top of the message. This service is effective when it is used with the broadcast communication service.

When a large amount of facsimile data is transmitted, a lot of time is spent in entering the destinations name. This service reduces labor.

3. PROBLEMS ON DESIGNING A WIDE AREA FACSIMILE MAIL SYSTEM (FMS)

(1) Human-machine interface

Many service specification items must be input in FMS communication when compared to P-P communication. The FMS access number and ID number for subject identification must also be input because communication is done with a facsimile machine via a public network or PBX. Various input methods can be used and are explained below. The Dual tone method or OMR sheet method is generally used for economical communication.

① Dual tone method

Information is input from the G3 facsimile terminal according to voice guidance normally. This is a general method, and many input items are necessary as well as a Dual tone. However, when a telephone or facsimile with one-touch key is used, the operation can be simplified by registering the FMS access number and local terminal ID number.

② OMR sheet method

Necessary information is entered on an OMR mark sheet, transmitted to the FMS as facsimile data, and analyzed in the FMS. This method is convenient because the user need only mark the entry form.

③ Dedicated adapter method

An adapter only for destination specification is used for each facsimile machine. This method is simple because input items are always transmitted automatically and the destination can be directly input. However, the adapter cost is high, and this method is not widespread.

④ Dedicated facsimile method

An adapter only for destination specification is mounted in the facsimile machines and a dedicated protocol is used for communication with the FMS. This method is simple but the terminal cost is high and it is rarely used because of the problems of using a dedicated protocol in a network.

(2) Delivery confirmation

Message distribution time is unclear when the FMS is used because messages are stored. Delivery time may shift considerably or a message may not reach the destination if it is sent while the remote terminal is busy or the remote terminal is out of forms.

The methods explained below are used. But a major problem is the increase in line cost when the FMS is used with the public network.

a. Transmission result report

This report is automatically issued from the FMS to the transmitter when a message is completely transmitted or a message cannot be transmitted in the specified times. It can be output only when a message cannot reach the destination.

b. Status check

The terminal accesses the FMS to check the transmission status of a specified message in the transmission wait state or after transmission.

c. Management report

The status of recent message transmission and reception are listed and output when it is requested.

(3) Manegement unification

① Addressing plan

A simple Addressing plan is necessary to obtain system that is easy to use. The subscriber adresses are the most important. The following two subscriber Addressing plan can be ssume and they should be used properly:

a. Use of subscriber telephone number: This is the same system as the P-P communication facsimile number. Numbers (addresses) can be memorized easily when this system is used.

b. Use of ID number: Numbers (addresses) can be shortene This system is convenient when more than one number is assigned to a facsimile machine.

The two systems explained below can be assumed for the addressing plan of a network with more than one FMS. The distribution system is generally used because maintenance is easy eve when the network becomes very large.

a. Distribution system: The FMS address is used in addition to the terminal address. They are connected and specified when a message is transmitted to a terminal under control of another FMS.

b. Centralized system: Terminal address in the network is set in all FMSs in common. Routing is based on the address. The addressing plan in the network is performed flexibly.

② Subscriber information maintenance

It is recommended to centralize maintenance of subscriber information even when two or more FMSs are used. A remote maintenance function for the FMSs is necessary.

4. OUTLINE OF FUJITSU FACSIMILE MAIL SYSTEM

4.1 Development Idea

Fujitsu is marketing a hyper media communication processor (HMCP). It is one of the facsimile mail systems.
The HMCP is developed as a device that executes communication of media such as facsimile, voice, text, and communication between the media. This facsimile mail function can be used to design a facsimile network. The HMCP considers the wide area facsimile mail system and problems in Section 3 are considered in the development.

4.2 Features

(1) G3, G4 facsimile mail

Mail for G3 and G4 facsimile which conforms to CCITT is possible. Of course, G3 and G4 facsimile messages can be sent together. The communication protocol, forms size, line density, and compression method are automatically converted in a system.

In addition, up to 42 G3 facsimile lines and up to 12 G4 facsimile lines can be used. Broadcast communication is also possible.

(2) Various service functions

Basic service types are broadcast communication including time-appointed transmission confidential and notice boards. Broadcast communication for to 5000 destinations is possible. Automatic attachment of Japanese-language destination names can be combined. In addition, a large-size magnetic disk can be used to store transmitted data so that the data can be retransmitted or transferred at a later time.

(3) Communication between centers

A network of HMCPs for a large-scale network can be designed. A network of up to 128 offices is possible and direct connection line and packet networks can be selected between HMCPs.

(4) PBX linkage function

The following communication service can be achieved when the HMCP is connected to the Fujitsu PBX FETEX-3000A series via the linkage interface:

a. Alternate service for a busy state

The status (free or busy) of facsimile machines connected to the FETEX-3000A series is monitored. HMCP alternate processing is automatically done in the busy state.

b. Omission of input of local terminal number

Extension number information of facsimile machines connected to the FETEX-3000A series is automatically reported to the HMCP to simplify the operation.

(5) Linkage with computer and FMS (HMCP)

There is a system that converts computer output information to facsimile information and outputs it. Broadcast communication can be done with linkage of this system and HMCP.

5. HMCP APPLICATION EXAMPLE

Figure 3 shows an example of the wide area network using HMCP.

Figure 3 is a domestic and international wide area facsimile network with the following service enabled:

a. Broadcast communication of facsimile can be done for domestic or overseas branches from the head office.

b. Communication cost can be reduced when leased-public or public-leased-public communication is used.

c. The head office HMCP can be used to monitor operating conditions of all HMCPs, maintain subscriber information, and collect journal information.

6. CONCLUSION

In this paper, we reported on problems of the wide area FMS network and on features of Fujitsu's FMS HMCP. In developing FMS, we are taking the following items into consideration:

① Improvement of computer linkage

Development of text and image data conversion function to achieve multimedium communication service

② Action for standardization

Flexible terminal connection for international standards such as G4 standard and MHS

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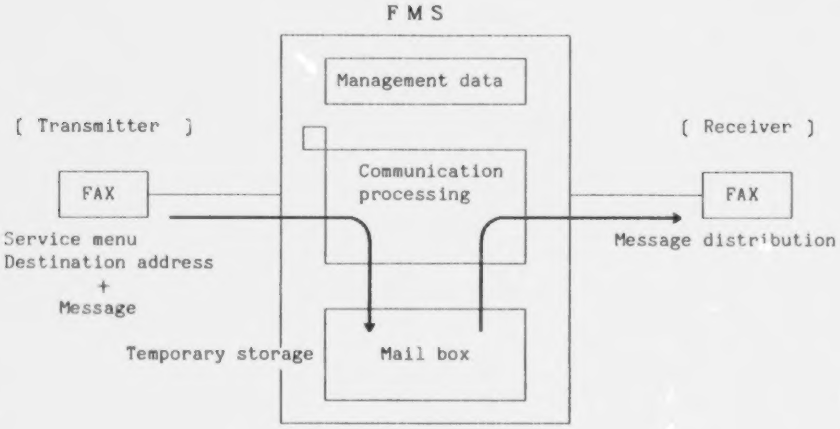
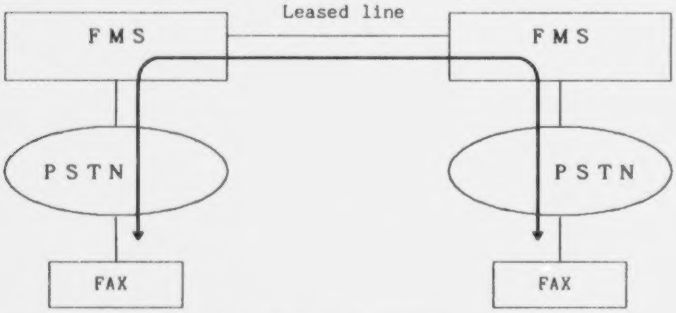
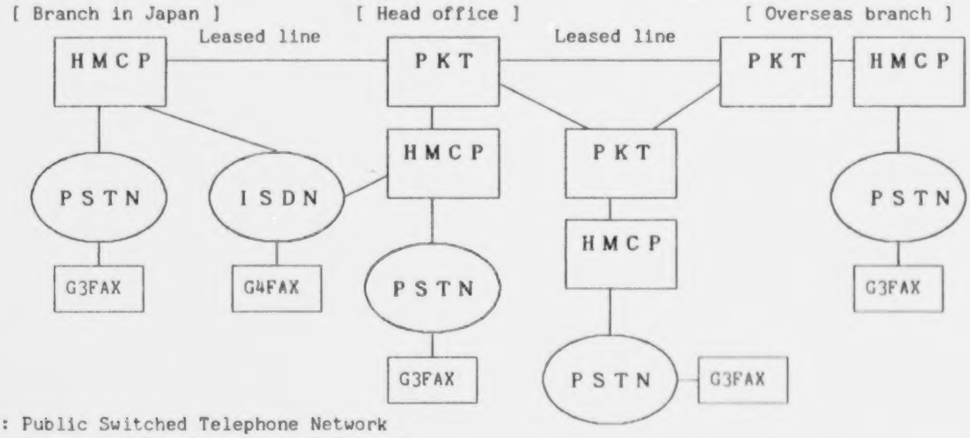

FMS
Management data
[Transmitter]
[Receiver]
FAX
Communication processing
FAX
Service menu
Destination address
+
Message
Message distribution
Temporary storage
Mail box

Figure 1 Facsimile mail principle


Leased line
FMS
FMS
PSTN
PSTN
FAX
FAX

PSTN : Public Switched Telephone Network

Figure 2 Communication with public telephone networks and leased lines connected


[Branch in Japan]
[Head office]
[Overseas branch]
Leased line
Leased line
HMCP
PKT
PKT
HMCP
HMCP
PKT
PSTN
ISDN
PSTN
HMCP
G3FAX
G4FAX
PSTN
G3FAX
G3FAX
PSTN
G3FAX

PSTN : Public Switched Telephone Network
ISDN : Integrated Services Digital Network

Figure 3 An example of the wide area network using HMCP.

DCME AND FAX ADAPTER

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1. ABSTRACT

The DCME (Digital Circuit Multiplication Equipment) is the technique for multiplying digital transmission line capacity to make more efficient use of limited communication resources. Recently Percentage of facsimile data in the traffic has been increasing and it reduces the DCME gain. The newly developed FAX ADAPTER efficiently recovers thus reduced DCME gain. This paper presents the performance characteristics and the description of the techniques employed in DCME and FAX ADAPTER.

2. INTRODUCTION

It has always been of great importance to common carriers to boost communication capacity and to save operational costs, whether the links are submarine cables, terrestrial long-haul cable links, microwave or satellite links. The DCME is the technique for multiplying digital transmission line capacity to make more efficient use of limited communication resources.

Based upon the fact that speech activity ratio of traffic to DCME is less than 40 percent, the DCME gain obtained by using DCME has been expected to be up to 5. Recently, the percentage of VBD (Voice Band Data) represented by GⅢ facsimile data, however, is rapidly increasing to more than 50 percent of the traffic. Since the VBD has the quite different nature from speech and boosts much the activity ratio, this trend has resulted in the reduction of DCME gain down to 3.

The newly developed FAX ADAPTER demodulates the GⅢ facsimile and sends it through 64kbit/s clear channel as the form of the original digital bit rate up to 9.6kbit/s. By adopting this technology, the combination of DCME and FAX ADAPTER will accomplish the gain of up to 5 even under heavy facsimile traffic environments.

3. DCME

3.1 FUNCTION OF DCME

DSI (Digital Speech Interpolation) and ADPCM (Adaptive Differential Pulse Code Modulation) are the principal DCME functions. Voice signals in a single circuit typically occupy only 30~40 percent of the available time. The DSI functions make use of the unoccupied time by interpolating several speech signals in each voice channel so that the gain of 2 to 2.5 is expected. The ADPCM functions compress a 64kbit/s PCM signal into 32 or 24kbit/s signal and accordingly the another gain of 2 to 2.6 is expected. When the both functions are combined, total gain of 5 to 6 is expected and is called DCME gain.

Mitsubishi proprietary DCME, DX-3000 employs the advanced ADPCM which can supports 9.6kbit/s GⅢ facsimile transmission at 32kbit/s. The maximum 61 facsimile channels can be handled by DX-3000. The DX-3000 has a 2Mbit/s or 1.5Mbit/s interface specified by CCITT Rec. G.700 series and has maximum 10 ports for trunk side and 1 port for bearer side.

The DX-3000 supports CCITT signaling systems No.5, No.6, No.7, R1, R2 and also Q.50. CCITT Rec. Q.50 specifies the signaling interface for the 64kbit/s on-demand clear channel establishment/disestablishment setting.

3.2 DCME GAIN

When all the traffic is voice, the DX-3000 expects the gain 5 to 6. However, when the percentage of VBD which includes the facsimile increases in the traffic, the DCME gain decreases to 3 to 4 because the VBD is a continuous signal and the DSI function does not operate effectively.

The gain curve of the DX-3000 in the various VBD percentage is shown in Figure 1. When there is no VBD, the maximum trunk capacity of DX-3000 is approximately 180 channels, which means the DCME gain of 6. The 50 percent of VBD in the traffic reduces the maximum trunk capacity of DX-3000 to approximately 90 channels, which means the DCME gain of 3.

4. FAX ADAPTER

4.1 FUNCTION OF FAX ADAPTER

The blockdiagram of FAX ADAPTER is shown in Figure 4. The FAX ADAPTER is installed between an exchanger and a DCME. When the facsimile detector detects 2100Hz tone in the signal from the exchanger, the transmit processor assigns a facsimile modem to the relevant transmit and receive circuits. The facsimile modem demodulates the signal on the transmit circuit to the original digital data whose bit rate is a maximum 9.6kbit/s. The demodulated data are multiplexed and sent to a DCME through 64kbit/s clear channels on the port 10 of the bearer. Voice signals from the trunk side are fed through the transmit processor and are sent out from the port 1 to 9 of the bearer without any modification. The voice signal received from the port 1 to 9 and the facsimile data received from the port 10 on the bearer are fed to the receive processor . The facsimile data is modulated by the facsimile modem, combined with the voice signal and fed to the trunk port.

The system operation of DCMEs and FAX ADAPTERs is shown in Figure 5. The frame format of the each interface is shown in Figure 6. The FAX ADPTR-A sends the signaling requesting 64kbit/s clear channels to the DCME-A using the signaling interface specified by CCITT Rec. Q.50. The DCME-A and the DCME-B prepare the 64kbit/s clear channel by searching the available unused slot in the bearer format so that the 64kbit/s clear channels are assigned randomly. The FAX ADPTR-A can transmit six 9.6kbit/s facsimile data in a 64kbit/s clear channel. The required capacity of a 64kbit/s clear channel are decided according to the bit rate of facsimile data and FEC ON/OFF condition. The BCH code (31,21,5) is employed for the error correction of the data in 64kbit/s clear channels and the performance is shown in Figure 7.

The FAX ADAPTER handles the GⅢ standard protocol specified by CCITT Rec. T.30, but not the proprietary facsimile protocol whose may be decided individually by the facsimile manufacturer. The FAX ADAPTER transmits the proprietary facsimile data through a voice route in the same manner as the voice. Figure 8 shows the FAX MODEM card in the FAX ADAPTER FC-3000, which handles 16 channels per one card. Table 1 and Figure 9 show the performance summary and the rack configuration.

4.2 COMBINED GAIN OF DCME AND FAX ADAPTER

When all of the facsimile traffic are GⅢ standard, the combined gain of the FAX ADAPTOR and DCME is expected to be 6 under FEC OFF condition. When some proprietary facsimile is included, the gain will decrease because they are carried through the voice route. Figure 1 shows the theoretical transmission capacity of DCME DX-3000 with FAX ADAPTER FC-3000 assuming the percentage of the standard facsimile in VBD is 75 percent. Even when percentage of VBD in the traffic is 80 percent, the combined gain of DX-3000 and FC-3000 achieves 4 while the gain of DX-3000 only is 2.3. In case of FEC ON operation, the combined gain is 3.3 under 80 percent VBD condition. Figure 2 shows the theoretical transmission capacity of DX-3000 with FC-3000 when the percentage of the standard facsimile in VBD changes. Figure 3 shows that when the percentage of VBD transmission in forward direction changes. When the percentage of the GⅢ standard facsimiles increases, higher gain GⅢ standard facsimiles increases, higher gain can be expected. In case of 90 percent standard facsimiles, the gain becomes more than 5 at the 80 percent VBD in the traffic. Since the facsimile transmission on the backward direction usually shows low activity e.g 5 to 10 percent and uses lower bit rate of 300bit/s, it occupies the less capacity than that on the forward direction. Accordingly the smaller percentage of forward VBD transmission results in higher gain. When the amount of forward and backward transmission is equal, the gain will become that shown by 50 percent curve in Figure 3, where the gain becomes more than 5 at the 80 percent VBD in the traffic.

5. CONCLUSION

A typical design approach of FAX ADAPTER and DCME is presented above.

The combined gain of DCME with FAX ADAPTER varies depending upon the traffic condition. However, the variation of the gain is smaller than the gain in the case of DCME only, and the higher gain is attained. The FAX ADAPTER, therefore, is effective for the transmission network with higher VBD percentage.

FC-3000 is a stand alone type and employs the open interface specified by CCITT Rec. Q.50. Accordingly FC-3000 can be applied to the DCME and DSI systems which has a CCITT Rec. Q.50 function.

6. ACKNOWLEDGEMENT

The author wishes to thank the engineers of Kokusai Denshin Denwa Co., Ltd. for their valuable discussions and suggestions during the development of the DCME and FAX ADAPTER.

7. REFERENCES

(1) "Development of Digital Circuit Multiplication Equipment (DCME)"
Hisaaki Ito, Yushi Naito, Kazuo Saito
Denshi Tokyo No.27(1988)

(2) "A Variable Bit-Rate Modem and Digital Circuit Multiplication Equipment for Satellite Communications."
Kazuo Saito, Seiya Inoue
Mitsubishi Electric ADVANCE September 1989

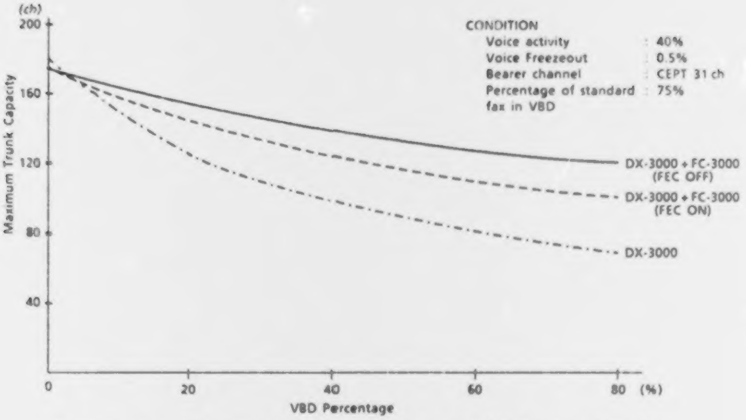


Figure 1 TRANSMISSION CAPACITY OF DX-3000 WITH FC-3000

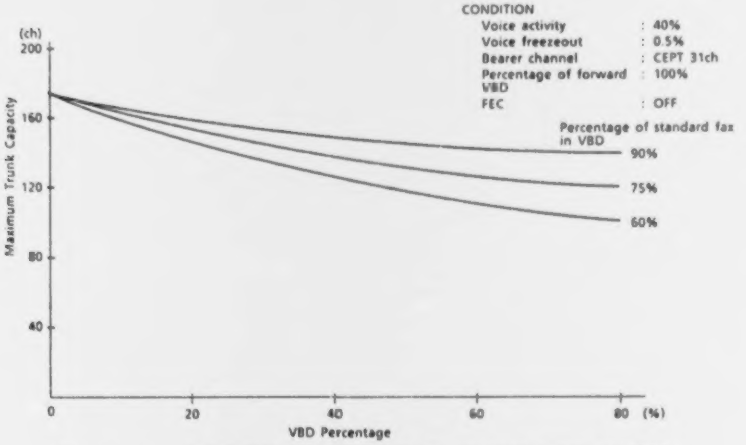


Figure 2 TRANSMISSION CAPACITY OF DX-3000 WITH FC-3000
(VARIATION OF STANDARD FAX IN VBD)

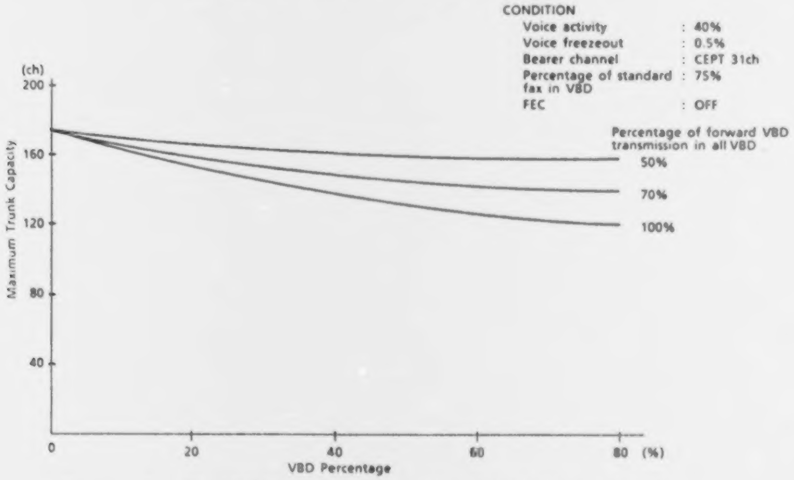


Figure 3 TRANSMISSION CAPACITY OF DX-3000 WITH FC-3000
(VARIATION OF VBD DIRECTION)

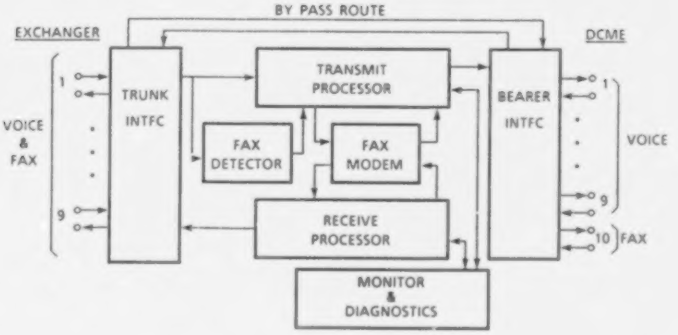

BY PASS ROUTE
EXCHANGER
DCME
VOICE & FAX
1
9
TRUNK INTFC
TRANSMIT PROCESSOR
FAX DETECTOR
FAX MODEM
RECEIVE PROCESSOR
BEARER INTFC
MONITOR & DIAGNOSTICS
1
9
VOICE
10 FAX

Figure 4 BLOCKDAIAGRAM OF FAX ADAPTER

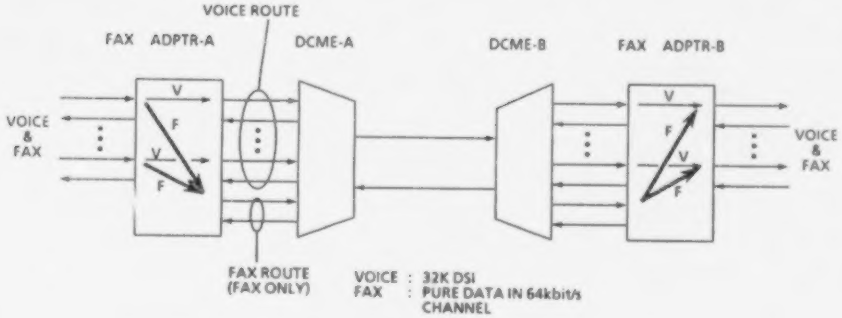

VOICE ROUTE
FAX ADPTR-A
DCME-A
DCME-B
FAX ADPTR-B
VOICE & FAX
V
F
V
F
VOICE & FAX
FAX ROUTE (FAX ONLY)
VOICE : 32K DSI
FAX : PURE DATA IN 64kbit/s CHANNEL

Figure 5 SYSTEM OPERATION OF DCME AND FAX ADAPTER

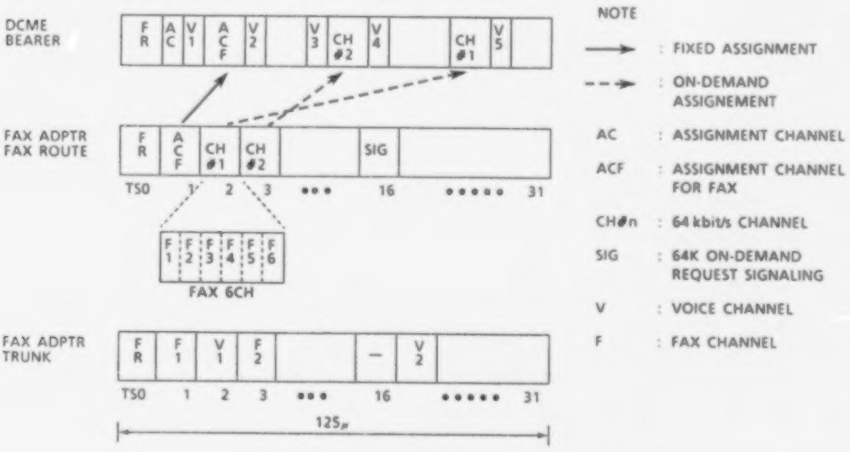

DCME BEARER
FR
AC
V1
ACF
V2
V3
CH #2
V4
CH #1
V5
FAX ADPTR FAX ROUTE
FR
ACF
CH #1
CH #2
SIG
TS0 1 2 3 ••• 16 ••••• 31
F1 F2 F3 F4 F5 F6
FAX 6CH
FAX ADPTR TRUNK
FR
F1
V1
F2
—
V2
TS0 1 2 3 ••• 16 ••••• 31
125μ
NOTE
: FIXED ASSIGNMENT
: ON-DEMAND ASSIGNEMENT
AC : ASSIGNMENT CHANNEL
ACF : ASSIGNMENT CHANNEL FOR FAX
CH#n : 64 kbit/s CHANNEL
SIG : 64K ON-DEMAND REQUEST SIGNALING
V : VOICE CHANNEL
F : FAX CHANNEL

Figure 6 FRAME STRUCTURE OF DCME AND FAX ADAPTER

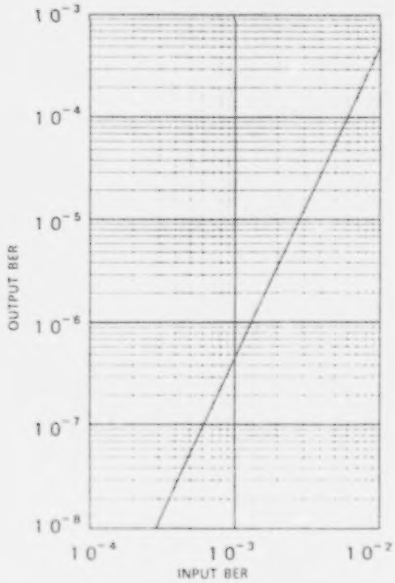


Figure 7 PERFORMANCE OF FEC BCH CODE (31, 21,5)

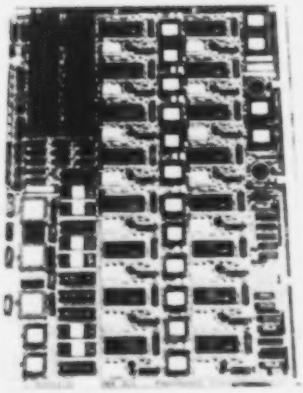
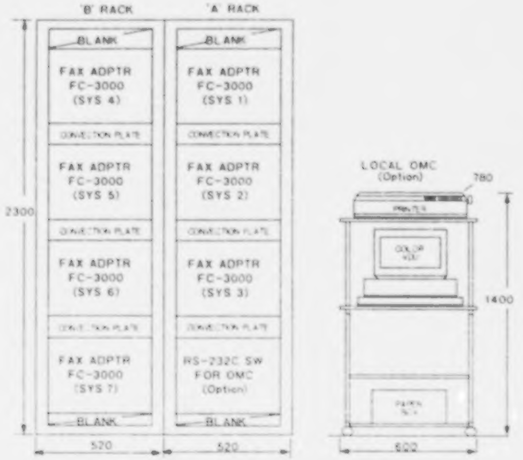


Figure 8 FAX MODEM CARD

Table 1 PERFORMANCE SUMMARY OF FC-3000

• FAX Compression gain	: 4 for GIII 9600bit/s facsimile (FEC ON) 6for GIII 9600bit/s facsimile (FEC OFF)
• Interface	: 9 CEPT's or 9 T1's for trunk side 10 CEPT's for DCME side
• Transmission capacity of GIII facsimile	: Max. 128 channels (16 channel basis expansion up to maximum)
• Protocol for 64kbit/s on-demand channel	: CCITT Rec. Q.50 Annex A



'B' RACK
'A' RACK
BLANK
FAX ADPTR FC-3000 (SYS 4)
CONVECTION PLATE
FAX ADPTR FC-3000 (SYS 5)
CONVECTION PLATE
FAX ADPTR FC-3000 (SYS 6)
CONVECTION PLATE
FAX ADPTR FC-3000 (SYS 7)
BLANK
BLANK
FAX ADPTR FC-3000 (SYS 1)
CONVECTION PLATE
FAX ADPTR FC-3000 (SYS 2)
CONVECTION PLATE
FAX ADPTR FC-3000 (SYS 3)
CONVECTION PLATE
RS-232C SW FOR OMC (Option)
BLANK
2300
520
520
LOCAL OMC (Option)
780
PRINTER
1400
600

Figure 9 RACK CONFIGURATION OF FC-3000

BEST COPY AVAILABLE

Computer-Mediated Communication, Some Organizational Implications

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1. ABSTRACT

Communication technologists, organization theorists and students of organization culture can benefit from an awareness of each other's research and perspective. This paper presents a selective review of research by organization theorists into the effect of information technology on organizations. The second section introduces organization culture, and offers some new speculation on the interplay between culture and computer-mediated communication.

2. INTRODUCTION

It is clear that information technology effects organization structure and culture, and that these in turn impact the society. For example, Weizenbaum [1] points out that our current welfare distribution organizations could not exist without computers. Telegraphy enabled railroads to grow and thrive, and telephones facilitated the expansion of many organizations. This paper explores some aspects of the relationship between information technology, organization structure, and organization culture. We will begin with a highly selective review of literature on the impact of information technology on organization structure and process. The second part of the paper discusses the link between changes in computer-mediated communication (CMC) and organization culture.

3. INFORMATION TECHNOLOGY AND ORGANIZATIONS

Leavitt and Whisler [2] may have been first to explicitly speculate on the effects of information technology on organization structure. They made many predictions about organizations of the 1980s, based on assumptions about trends in information technology in the late 1950s. Their predictions included the shrinking of middle management, increased planning and creativity at the top, a trend toward centralization, and the development of a clearer line between top and middle management. The motivations for these changes was expected to be the power of computers for providing management information and the automation of decision making through advances in management science and artificial intelligence.

While their predictions have been born out in some organizations, those successes do not seem to be due to the causes envisioned by Leavitt and Whisler since they overestimated our ability to automate management functions and overlooked many important factors. For example, they stated that "Current research on the machine simulation of higher mental processes suggests that we will be able to program much of the top (management) job before too many decades have passed." They were caught assuming the validity of the conventional wisdom of their times. At the same time they failed to anticipate developments such as microcomputers, reduced communication costs, and a myriad of economic and political changes which have effected organization structure and process. This is not to diminish their contribution. Theirs stands as the most important paper on this topic, not because of the answer they gave, but because of the question they asked. (When asked what he thought of computers, Pablo Picasso dismissed them as unimportant because they only gave answers).

Since Leavitt and Whisler, many authors have addressed the impact of information technology on organizations. One of these, Leifer [3] refines the question by considering both organization structure and the type of computer based information system (CBIS). He combines a taxonomy of CBIS architecture derived from Burch [4] and a taxonomy of organization structures derived from Mintzberg [5]. Table 1 summarizes what Leifer feels are the compatible organization type and CBIS architectures. This two-dimensional approach shifts our focus, and raises another important question: "which types of organization are likely to benefit from likely technological changes?" Many authors, for example, McCarthy and Bluestein [6], predict a shift in economic advantage to decentralized architectures, which would result in a marginal advantage for type-B divisionalized and adhocratic organizations.

Huber [7] also adds richness by focusing on decision making process and external intelligence memory as well as organization structure. He also recognizes the increasingly critical role of communication technology. Huber states 14 propositions such as "use of computer-assisted communication technologies leads to a larger number and variety of people participating as information resources in the making of a decision." An example of this effect may be seen at Xerox, where thirty-four business units submit plans over an electronic network, as input to the annual planning and control process (Rockart and Short [8]). This, and Huber's other propositions are of interest to practitioners and to researchers who may test them empirically.

Drucker [9, 10] has made what is perhaps the best-known recent prediction of the effects of information technology on organizations. He feels that the modern business enterprise, which dates back to the mid-nineteenth century, is undergoing its third fundamental change. The first was the separation of ownership from management, the second was the introduction of the hierarchical command-and-control organization structure, and the third, which is beginning now, is a shift from an organization of departments and divisions to an "information-based" organization of knowledge specialists (with some of the characteristics of Liefer's "professional bureaucracy" and "adhocracy").

Drucker predicts that in twenty years organizations will be relatively flat, with fewer than half the levels of management of today's organizations and no more than one third its managers. The hospital, university and symphony orchestra are current day examples of knowledge-based organizations, as was the British civil administration in India before World War II. These organizations are comprised of relatively autonomous specialists who have their own expertise, and act on information received from within and outside of the organization.

He believes this change will occur for several reasons, but the primary motivation will be improved information technology, which means:

> fewer layers of management are needed to relay information and orders (i.e., span of control can be increased)
>
> it is possible for geographically dispersed specialists to work together
>
> it is easier to ignore hierarchical channels, communicating directly with specialists and managers

The requirements for knowledge-based organizations include:

> clear, simple, common objectives
>
> everyone being aware of and responsible for coordinating and communicating with those who rely upon him or her for information
>
> everyone constantly thinking through what information he or she needs to do the job and make a contribution.

The problems facing the managers and designers of knowledge-based organizations include:

> developing rewards, recognition and career opportunities for specialists -- there will be fewer management positions and employee retention will be difficult
>
> creating a unified vision -- specialists can become lost in their specialties, and professional goals and values can outweigh those of the organization
>
> devising the management structure for an organization of task forces -- there are several models, but no one yet knows how to do this
>
> ensuring the supply, preparation and testing of top managers -- promotion and training through the ranks will not be an option.

4. ORGANIZATION CULTURE

In addition to organization structure and process, management theorists study organization culture. Schein [11] defines organization culture as "a pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, that have worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems."

Note that some cultural patterns are felt and perceived, making them difficult to identify explicitly. They are subconscious assumptions, which are difficult to observe. As a guide, Schein analyzes cultural paradigms into five basic categories: assumptions about the organization's relationship to its environment (dominance, submission, etc.), the (philosophical) nature of reality and truth, human nature (good, bad, perfectible, etc.), human activity (active, passive, fatalistic, etc.), and the nature of human relationships (cooperative, competitive, etc.).

While each of these cultural aspects is of interest, there is a direct connection between the last and CMC, because making it easier for people to communicate only pays off to the extent that they are willing to cooperate. For example, the Internet may make it possible for me to post a query, but this will be of no avail if no one is willing to reply. Furthermore, why would a stranger take the time to reply to my query? The organization served by the Internet is the academic community, but the same sort of question may arise within a business or other organization. A worker might decide to withhold relevant information from a colleague he or she sees as a competitor, to the detriment of the organization. Even though cooperation and collaboration may be in the best interests of the organization, it is often costly to the individual, see Press [12]. This is analogous to the biological "tragedy of the commons," which leads to the destruction of our physical environment.

As Leifer led us to ask which types of organization structures are likely to benefit most from changes in CMC technology, we might now ask which types of organization culture are likely to benefit? It would seem that organizations with a cooperative, as opposed to competitive culture should have a marginal advantage as CMC technology improves. Even if nice guys do not finish first, they will do somewhat better.

Do some organizations have cooperative cultures, and can one identify them? Schein feels it is difficult, but possible, to analyze organization culture, and he presents some techniques for doing so. Compaq and the Herman Miller office furniture company are both reputed to have cooperative cultures.

Compaq is described in The Economist [13] as pursuing cooperation with suppliers and dealers, and internally. They have worked closely with Intel during the specification and development of new chips and with Microsoft during specification and development of the OS/2 operating system, and refuse to sell directly in competition with their dealers. Internally,

> employees are encouraged to work together as much as they possibly can. Cutthroat competition between departments and individuals is discouraged; territorial battles are frowned upon. Important decisions are taken not by a coterie of top managers, but by what the company calls "the process" (a mystical name for old-fashioned cooperation). Anybody with an opinion is encouraged to speak, regardless of whether the subject falls within his brief or not.

Barrett [14] describes the culture at Herman Miller as reflecting the religious beliefs of its founder. Decision making is highly participatory, there is a high degree of concern for employee working conditions, and all employees are shareholders and participate in profit sharing.

We might also ask how organizational culture is established and whether it can be modified. In the case of Compaq and Herman Miller, the culture seems to have been established from the outset by the founders. Still, a key element in Schein's definition of culture is that it can be taught to newcomers, and Barnard [15], one of the oldest texts on management, states that securing ongoing cooperation in the face of a changing environment and shifting goals is the central function of the executive. More practical prescriptions for instilling a cooperative culture are found in Barrett [14] and Kanter [16].

If these views are correct, management should be able to modify an organization's culture to some extent, moving it toward greater cooperation. Doing so may have intrinsic advantages and also put the organization in a better position to exploit evolving CMC technology.

5. REFERENCES

1. Weizenbaum, Joseph, "Computer Power and Human Reason," W. H. Freeman and Company, San Francisco, 1976.
2. Leavitt, H. J., and Whisler, T. L., "Management in the 1980s," Harvard Business Review, November-December, 1958, pp 41-48.
3. Leifer, R., "Matching Computer-Based Information Systems with Organizational Structures," MIS Quarterly, March, 1988, pp 63-73.
4. Burch, J., "Network Topologies: The Ties that Bind Infor-mation Systems," Data Management, December, 1985, pp 34-37.
5. Mintzberg, H., "The Structure of Organizations," Prentice-Hall, Englewood Cliffs, NJ, 1979.
6. McCarthy, J. and Bluestein, W. M., "Is Client Server Cheaper?," The Professional Systems Report, Forrester Research, Cambridge, MA, August, 1990.

7. Huber, G. P., "A Theory of the Effects of Advanced Information Technologies on Organizational Design, Intelligence and Decision Making," Academy of Management Review, January, 1990, pp 47-71.

8. Rockart, J. F., and Short, J. E., "IT in the 1990s: Managing Organizational Interdependence," Sloan Management Review, Winter, 1989, pp 7-17.

9. Drucker, P. F., "The Coming of the New Organization," Harvard Business Review, January-February, 1988, pp 45-53.

10. Drucker, P. F., "The New Realities," Harper and Row, 1989.

11. Schein, E. H., "Coming to a new Awareness of Organizational Culture," Sloan Management Review, Winter, 1984, pp 3-15.

12. Press, L., "Incentives to Participate in and Effects of Computer-mediated Communication Systems," Conference of the International Systems Science Society, Portland, July, 1990.

13. The Economist, "The World's Fastest Growing Company," March 19, 1988, pp 67-68.

14. Barrett, F. D., "Teamwork -- How to Expand its Power and Punch," Business Quarterly, Winter, 1987.

15. Barnard, C. I., "Functions of the Executive," Harvard University Press, Cambridge, MA, 1938.

16. Kanter, R. M., "How the Kinder, More Cooperative Corporation Wins," Working Woman, May, 1989, pp 118-120.

CBIS ARCHITECTURE

TYPE OF ORGANIZATION	Stand Alone PCs	Centralized Systems (Dumb terminals)	Distributed Systems (Smart terminals)	Decentralized Systems (Peer networks)
Simple	X			
Machine Bureaucracy		X		
Professional Bureaucracy		X	X	
Divisionalized Form A		X	X	
Divisionalized Form B				X
Adhocracy				X

Table 1. The X's indicate a good match between organization structure and CBIS architecture. Form A divisionalized organizations are characterized by centralized divisions, with common financial and other controls whereas Form B divisions are more autonomous, but linked by a common culture. (Adapted from Leifer [3]).

TELECOMMUNICATIONS AND THE HUMAN SERVICE INFRASTRUCTURE IN REMOTE AREAS

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Harry Hurley
Control Data Corp.

David Hoffmann
Des Moines River
Telemedia Project

ABSTRACT:
The quality of life in remote areas is largely determined by economic development and access to human services. This paper explores the ways telecommunications technology can support a viable human service infrastructure using the school as a community center. By expanding upon existing distance learning networks, rural communities can offer residents services and experiences equivalent to those available in an urban environment.

INTRODUCTION:

Economic opportunity for persons in rural areas in the information age is predicated on the development of competitive human capital. Simply put, there will be *no* business; *no* jobs; and *no* income unless rural workers can compete directly with their urban counterparts. To do so, they must be trained in the use of modern technologies and be made aware of emerging subject matters. Clearly, telecommunications is an essential means whereby rural residents can gain access to these capital-producing skills. Distance learning and the improved access to information associated with it makes it possible for those living in rural communities to build their human capital to a competitive level.

However, human capital alone is not sufficient for a vital rural community. If the quality of rural life is not equivalent to that in urban settings, human capital will migrate and only those unable to compete will remain. (Bollier, 1988) As a result, quality of life must have equal priority with capital building in any effective rural development plan.

We take the position that the human services are at the core of quality of life. They provide the support needed by individuals and families in modern society. Without a viable human service infrastructure, we argue, there is no potential for the long term survival of rural communities. Yet, these are infrastructures which have eroded alarmingly in the past two decades. Many communities have no hospitals or doctors; social service agencies have migrated to the seats of county governments; and the forces which once drew rural residents to their villages and towns are now attracting them to regional centers or to the metropolis. These are trends which can only be reversed by a new human service paradigm - one which creates rather than destroys community centers.

A SCHOOL-CENTERED HUMAN SERVICE PARADIGM:

The emerging rural human service paradigm is one which views the school as the primary service delivery mechanism. As the sole surviving institution in many communities, the school is uniquely positioned to assume responsibilities for front-line interaction with rural clients. It is also an institution whose role as a human service provider is already expanding. This means that schools have much of the expertise needed at the core of a new human service infrastructure.

As the school becomes the local human service provider, it draws upon a new view of the client-provider relationship. This new perspective is at the core of the school-centered paradigm because it emphasizes the *potential* of the client rather than his/her problems. Consequently, the interaction between provider and client at the point of care/service become information intensive. This, in turn, makes it possible for new patterns of service delivery which can be configured using telecommunications technology.

In an earlier paper, we suggested that this new perspective does away with much of the traditional *institutional* model of the human services.(1989) For many clients, this means that they no longer need to travel to a physical location to receive services. Instead, they can interact with care providers at a distance using telecommunications technology to; a) establish their service needs, b) develop a plan for meeting these needs, and c) in some instances actually receive service at a distance.

BUILDING A HUMAN SERVICE INFRASTRUCTURE:

To put the above paradigm in place, rural communities must build on the existing human service infrastructure. In most communities, this amounts to enhancing the services offered by the school and integrating them with those of other agencies. This can best be done by beginning with the human capital development function of the school and gradually transforming the institution toward the comprehensive human service paradigm. In the following Stages, we suggest how the infrastructure might evolve along with its telecommunications support network.

Stage 1: Distance Learning: This is the Stage where most rural schools find themselves at present. It is characterized by the metaphor of "school as information source" and is operated in a model where clients are undifferentiated and services are packaged in standard units.

Network: The telecommunications system here is rarely a true network. It usually involves one-way transmission of audio and video signals from the school to remote locations. The mode of operations is essentially one of broadcasting and network technology is quite traditional.

Service: Clients can select the information "packages" they wish to receive, but they cannot tailor them to their own needs and/or objectives. Services are *not* based on the unique condition of the client, and the measure of their effect is usually one of testing client knowledge before and after service delivery.

Stage 2:The Extended School: This Stage uses telecommunications technology to *extend* the school to remote sites. The metaphor at work here is that of many "one room schools" connected to a learning center in real time. The metaphor is that of many "one room schools" connected to a single learning center. The client may still elect to receive broadcast information, or he/she may go to one of the remote sites in the network where two-way communication is available.

Network: This network is considerably advanced over that of Stage 1. It supports two-way audio and video communications throughout the network so that individuals at any site can interact with those at other sites in real time.

Services: Standard "packages" of information are still the core service offered clients. If any individual "tailoring" of services occurs, it is directed at a remote site and not at individual clients. There is, however, the capacity for providers to respond to the requests of individual clients within the framework of each "package".

Stage 3:Transforming The School: This Stage represents a significant step toward the "infrastructure model" in that it expands the services offered by the school. The metaphor for this Stage is that of the school as a "shopping mall" where a wide selection of family support services are offered. In addition to the expansion of the service array, this Stage provides a two-way communication link between client and service provider.

Network: The network in this Stage links providers to both remote sites and to the homes of clients. Remote site capabilities remain as in Stage 2, but clients can interact with providers through telephone services. In effect, clients can remain at home and receive broadcasted information while receiving individual consultation through local telephone networks. The broadcast services in this network include the use of cable services where they might exist in small towns.

Services: The provision of what we call "family support services" grows out of the recognition by educators of the fact that the learning potential of students is largely determined by factors outside the school. This is especially true in remote areas where opportunity may be severely restricted with dysfunctional effects on the family. This service array begins to position the school as the community human service provider with close ties between the school and other agencies.

Stage 4: Individualizing Services: In this Stage, the school begins to take on a more generalized provider role. It does this by taking individual needs into account in planning and delivering services. This transforms the working metaphor into that of an "electronic yellow pages" where individual choice becomes the essential service dynamic. The network supports the personalization of service through the use of switching and transmission technologies which permit unique links between clients and providers.

Network: The major addition to the network of Stage 3 is the use of switched services through the local telephone network. As full digital switching becomes a reality in local telephone centers, the network can route broadband services directly to the individual client through cable networks, or it can provide compressed video via twisted pair wiring. In this way, it is possible to route unique services to particular clients and, if appropriate, create billing records for provider reimbursement. The network also embraces county- or region-level agencies in order to address the full range of client needs.

Services: In order that truly individual services be provided, the school must become a *human service center*. This means that it contains the information needed to provide up to date services as well as access to client records. At this point in infrastructure development, the school begins to augment the skills of its staff to include the full range of professional services needed by clients.

Stage 5: The Community Human Service Center: This Stage represents the integration of the *human capital* and *human service* themes discussed in the Introduction to this paper. To realize the objectives underlying these themes, the school must be integrated with social and economic systems outside the community. This is a matter of networking the school with other institutions and agencies in a metaphor of the school as "node" in an information processing structure.

Network: In this final form, the local network is tied to a larger (usually state-wide) system. (State of Minnesota, 1989) This expanded network gives both the school and its clients access to voice, data and video services via switched digital channels. The network provides for two-way transfer of information; services flow from higher levels in the system to the client; information is aggregated upward for policy analysis and management.

Services: This level of service extends well beyond the traditional offerings of earlier Stages. Clients are able to identify their needs and opportunities with full knowledge of social and economic trends. They can access information through the state-wide network to determine how their personal human capital should be developed. They can also identify services which might enhance the quality of their lives and the steps needed to access them.

SUMMARY:

Although most of the attributes of the above paradigm are in place in remote areas, they have not, as yet, been integrated into a working human service delivery system. This is probably due to the fact that telecommunications technology has been the driving force behind the development of rural networks. This has resulted in electronic highways which go in puzzling directions and are travelled by only a few people who can find their way in an information rich environment.

If those who live in rural areas are to realize the benefits of modern society, the focus of development must shift from highways to communities. As we see it, this amounts to an emphasis on human capital and the quality of life in remote areas. In the paragraphs above, we have attempted to make a case for several Stages whereby the school might become an agent responsible for development of *both* human capital and quality of life. By following the evolution of Networks and Services outlined above, rural communities might be able to establish a human service infrastructure on which viable social systems can be built.

REFERENCES:

Ammentorp, W., Hurley, H. and Hoffmann, D. (1989) Delivering Human Services in Remote Locations. Paper presented at Pacific Telecommunication Council Annual Meeting. Honolulu, Hawaii.

Bollier, D. (1988) The Importance of Communications and Information Systems to Rural Development in the Unites States. Truro, MA: Aspen Institute.

Casey, L., et.al. (1990) Choosing Minnesota's Information Future. Northfield, MN: Carleton College, Technology and Policy Studies.

Dillman, D. (1985) "The Social Impacts of Information Technologies in Rural North America," Rural Sociology 50:1-26.

Perlman, R. (1989) "Technology's Role in Restructuring Schools," Electronic Learning June, p. 8.

Schmuck, P. and Schmuck, R. (1990) "Democratic Participation in Small-Town Schools," UCEA Review, XXXI (3), p. 6.

State of Minnesota (1989) STARS Is Coming to Minnesota. St. Paul, MN: State of Minnesota, Department of Administration.

Communication and Information Technologies In Development Programs in Peru

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ABSTRACT

This study deals with the results of research we have been carrying out within IPAL as to the use of video and microprocessors in the activities of development NGOs.

FUNCTIONS OF DEVELOPMENT NGOs IN PERU

Throughout all productive sectors in Peru we find institutions and projects which define themselves as specifically addressed to the promotion of development. Thus we have organizations involving agricultural promotion, educational extension services, diffusion and legal advisory services, health aid, the development of small cottage industries or a generalization of certain survival strategies. To speak of development in Peru is an absolute necessity and no institution, enterprise or technological innovation can fail to take into account the enormous shortages and demands.

The NGDOs, Non-Governmental Development Organizations, are non-profit institutions characterized by their dedication to promotional and development work. Their efforts are addressed to the service of society through technical and productive projects, together with legal, advisory, training, information, public health, education and other activities. They exercise a constant rational effort with respect to societal reality, "developing their reflections at three levels: with respect to the immediate realities within which they act; regarding Peruvian society as a whole; and as to the relationships between the concrete reality in which they act and Peruvian society."(1)
The services which they render are characterized by their forms of support and their cooperation in the activities carried out by the people's organizations, which leads to a political stand seeking change, "...from the viewpoint of co-operation and direct bonds with the organized sectors, these NGOs have a clear tie with the world of politics. This is so, since, to a lessor or greater degree, all of them have before them the option of social change within the frame-work and the interests of the people's sectors."(2)

As to their sources of financing, the majority of NGOs receive their economic support through the financing of their projects on the basis of international technical cooperation: to a lesser degree, they obtain their own financing resources depending on the type of work carried out by the institution.

According to the Directory of the Asociacion Nacional de Centros, ANC,(3) (National Associa-tion of Centers), there are about 392 units at the national level, including university research centers, coordinating units and networks, with 56.4% centered in the Lima area. The Peruvian NGOs are associated within the ANC and organize their activities basically with respect to three aspects:

1. The work programs, directly related to the beneficiaries: society, campesino population, native communities, labor sectors, district groups, the family, women, children and youth.
2. Promotional and service activities, which include survival strategies, health, education of community members (educacion popular), self-education, folk communications and culture, self-management, rural development and appropriate technology, ecology and the environment, pastoral instruction, municipal advisory services and local governments, legal counselling, human rights and publications.

3. The research activities, which are being developed in different study areas: demography, economics, politics and society, history and anthropology, agriculture and the Andean setting, urban development, culture and education, health, human rights, ecology and international affairs.

On the other hand, the activities performed by the NGOs represent a great contribution to the State, appearing as an alternative or parallel and autonomous option in view of insufficient State action.

VIDEO AND DEVELOPMENT IN PERU

The media are not alien to this context. The introduction of an apparently domestic technology such as the half-inch video tape involves significant projections among development promotion activities.

The production of alternate video for the people

To understand the production of alternate video for the people, it is necessary to consider the matter within the context of what communications mean as a line of action for the NGDOs in Peru. According to the Directory of the National Association of Centers, education for the people and communications are the main lines of action, with 189 and 127 NGDOs, respectively, which in one way or the other carry out these activities.(4)

A recent report(5) indicates that there are nearly 100 organizations which to a lesser or greater degree perform activities related to the production and dissemination of development video, which is called "alternate video for the people." The size of this market is almost unique to Latin America and is due to the specific conditions prevailing in our country.

The interest in the development of this type of video comes from individuals who were previously dedicated to rural video, the production of audiovisual features, pastoral and union productions(6). The first large promoter and personnel trainer was CESPAC (Center for Audiovisual Teaching Aid Services for Training), in whose production units and extension services many development video specialists were formed.

The main productions centers are the Chaski group, with movie experience, Imagen, Video Centro, Chavic, Calandria, ADEC-ATC, TV-Cultura and Nexos, among others. These institutions have as their objectives; education, dissemination of innovations, social promotion and participation within the marginalized urban sectors and in the campesino communities.

In their productions, the NGDOs give priority to production over dissemination. The preferred productions are the documentary and records of events, followed by narrative reports. Fiction is the least common feature. This is confirmed in view of the lag in generating an audiovisual language which is at the same time attractive and in keeping with local cultural forms. Production reveals problems in dramaturgy and narrative structures lacking systemized experiences, as well as mythicization.

Most of the work is done in Lima and its provinces, followed by the southern part of the country. The main beneficiaries are women's and district groups.

The majority of the organizations offer video up to three times a week with an average of 40 spectators per showing. The video forum is the most common method employed and generally lasts more than an hour.

The video libraries contain an average of 100 programs, of which about half are foreign and the remainder national.

The video libraries best known to users are Video Centro, IAA, IPAL, Videoteca Alternativa and Chaski. At the present time, IPAL Videored receives the greatest number of requests in view of its stock and services. It has about 164 videos, most of them journalists' analyses of urban and rural issues, from 15 different countries, particularly Latin America. Videored publishes a quarterly bulletin offering transcription and copying services at low cost. It publishes a general catalog of Latin American video and provides for diffusion of the material.

The sectors covered by those responsible for diffusion are principally organizations in marginalized urban sectors and campesinos. The topics most requested are on agriculture, women and education.

The NGDOs employing video constitute a dynamic market. They represent an alternate use of a new communications technology. They perform a compensatory function at those places not reached by public services. They are another demonstration of the efficiency of private initiative vis-a-vis government inadequacy. The present constraints would tend to correspond more to a state of development and to the vestiges of prejudices of the 70s, rather than the very possibilities for use of the media to support development.

MICROPROCESSORS AND THE NGDOs

Hardware

A study performed in IPAL(7) revealed that 83% of the NGDOs have at least one microprocessor. These were generally acquired between 1987 and 1989. There is an average of 4 computers per NGDO and 90% are IBM or IBM-compatible, the most common being PC/XT, followed by the AT and the PS/2.

The most commonly used peripheral equipment is the matrix-dot printer, then modems, the mouse and laser printers. Other equipment include plotters, scanners, interfaces, color printers, tape back-up, CD-ROM and hard disks. All of them, depending on their characteristics, are used for the printing of documents, editing and layout of publications, communications, graphics, digitation of vignettes, data storage, back-up copies and final reports.

Among the institutions, 45.6% plan to acquire new hardware. Among future acquisitions were Amiga 2000 computers, PS/2, printers, scanners, mouse, hard disks, color monitors, etc. These acquisitions are addressed to expand operating capacity, speed and memory. Most of the equipment shall be acquired through donations or agreements. In any event, renovation would occur within about five years.

Personnel Training

There is a 25% use rate at the centers, with an average of 11 users per center.

Personnel training in the use of computers is a very important factor. The characteristics for training of administrative personnel (accountants, assistants and administrative staff) are very different from that required by a professional development researcher. The training of the latter is more complex, since use of the computer in this case offers far greater possibilities than for an administrator whose activities are more conventional, exact and concrete(8)

Another limitation refers to the lack of skilled individuals to organize, plan and provide for maximum utilization of technological capacity, and personnel having suitable knowledge to be able to integrate the activities of the institution and work with the computers.

Software Applications

In keeping with the priorities established, software applications were as follows:

1. Research
2. Administration
3. Documentation centers
4. Publications
5. Other activities: graphics, telecommunications, script drafting, documents and projects, project follow-up, word processing, training, services to micro-entrepreneurs, directories and subscriber files.

Generally speaking, "research" tends to be mainly word processing more than data bank handling, and, together with administrative activities, acquires great importance in the work done at the centers.

"The software used is mainly for administrative purposes. The market tends to condition this situation since it basically offers and promotes the software, highlighting its importance in entrepreneurial applications. The use of programs in private activities and especially for accounting is far more developed since it is in this field where the majority of consumer-users lie."(9)

The most common word processing program is WordStar, followed by WordPerfect, Word Microsoft and Multimate. Among the data bases, DBase stands out in its different versions, and Microisis. Other programs mentioned were Cardbox and Fox base. In third place came the spreadsheets, the most commonly used was Lotus 1.2.3., followed in a very limited manner by Quattro and Multiplan. In fourth place came the utilities, Norton and PC Tools being the most common. Next came graphics, with Harvard Graphics being the most used. It was followed by programs used for the layout of publications, for statistical procedures, project software and for communications, language, etc.

Most of the software is obtained through copies and, to a lesser extent, through purchase, donation or programming. However, it is necessary to motivate the production of programs which are more suited to local needs, maintaining their compatibility with the programs on the market.

New Needs

The research revealed that the NGDOs acknowledge a certain order of priority for their needs;

1. Constant training of personnel and the acquisition of peripherals.
2. Engagement of outside maintenance services.
3. Hiring of trained technical personnel.
4. Others: acquisition of programs and inputs.

The problems most frequently arising are the virus, the urgent need to train personnel and congestion among users. Other problems are the dependence generated by the use and the need to implement so much equipment as well as suitable premises.

The operations carried out by computers were previously performed manually or outside services were obtained. Of the institutions, 100% of those surveyed agreed that the quality of the work has improved with the use of computers at the center, and 50% of the organizations surveyed asserted that their work depended upon the use of computers.

Networks

Those organizations already forming part of some network named the following systems: INTERDOC, GEONET, CEPIS, Red Salud y Trabajo (RST), PERUNET, SATIS, INFONET, BIT NET, REPOP (National Demographic Council Network), REPIDISCA, COMNET, REDALC, POPIN, UNAMAZ (covering the Amazon basin), the Christian Editors Network, Industrial Network, ISAMAZ (Information System for the Amazon), RIAP and the Information Network on Rural Problems of the Agrarian University Documentation Center.

In truth, few organizations take part in the networks. This is due to the fact that, since they do not have full command of their equipment in their daily activities, they consider it inconsistent to participate within a network, at least for the short term. Another reason is that few centers have modems and software for communications or a sufficient number of telephone lines. It is interesting to note that, among the national networks mentioned, three are located in the Amazon region, their development being due to the isolation of this area.

Unquestionably, there is marked interest in participating or accessing information networks, data banks, documentation centers, etc., since this would permit expanded access to large quantities of data which, at present, are only being stored and utilized by a limited number of individuals but which might be of great use for research and decision-making. Moreover, it offers the possibility of data an information exchange almost immediately over long distances which would mean considerable savings of time and, from the social perspective, a great contribution to the integration process to the extent that it would constitute one of the media promoting bi-directional message exchange.

TENTATIVE CONCLUSION

Soon, the NGDOs shall pass from isolation to connection with networks in accordance with their interests or lines of action and it is expected that the systems shall be at the national level. There is a gradual appropriation of information technology by the NGDOs and there is already production of animated video in computers. The video producers for development purposes increasingly seek additional appearances over TV channels and access to NGDO programs is becoming increasingly common.

Microprocessors and video are media which have been incorporated into the daily activities of the development projects after going through a fetish phase or being rejected as foreign technology. Users and beneficiaries now tend to recognize and accept them as functional instruments. However, perhaps the next step will be that of passing from the use of technology for the beneficiary to the use of technology by the beneficiary. In the final analysis, they are media for communications, freedom of speech and expression. If development and improvement of standards of living presume democratization, this, in turn, demands that all those participating have the possibility of providing and receiving information without restriction, demanding cultural appropriation of the media and their language, and of the hardware and software.

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(1) Las ONG en el Peru: algunas notas, Federico Velarde, in "El Peru en una encricijada. Centros de Promocion: Retos y Alternativas. CEPES. Lima, February 1988, page 189.

(2) Federico Velarde, op. cit.

(3) Directorio de la Asociacion Nacional de Centros. Lima, September 1988

(4) Directorio de Organismos No Gubernamentales de Promocion Social, Investigacion y Desarrollo del Peru. Asociacion Nacional de Centros. Lima, September 1988.

(5) Caballero, Caceres, Macassi, Mendoza and Yep. Apuntes para un diagnostico del video popular y alternativo en Peru (paper). IPAL, Lima, March 1989.

(6) De lo alternativo a lo popular (paper). IPAL, 1989.

(7) Incidencia de las Microcomputadoras en el Trabajo de Organizaciones no Gubernamentales de Lima. Patricia Yep Chou. Ipal -- Universidad de Lima, June 1990.

(8) Yep Chou. op. cit. page 105.

(9) Yep Chou. op. cit. page 105.

VILLAGE RADIO SERVES DIVERSE NEEDS AND CULTURES IN PACIFIC RIM

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ABSTRACT

In the simplest of terms, Village Radio is a communication medium, owned and operated by the community it serves. Village members are typically bound together by territory, whether they reside in an isolated hamlet in Tonga or a city block in Tokyo. They are also apt to share interests, needs, culture or history. This paper will focus first on various "sounds" of Village Radio, utilizing examples from countries all around the Pacific Rim, then discuss equipment, propagation and legal aspects before turning to a future full of promise for scaled-down, participatory radio communications systems.

WHAT IS VILLAGE RADIO?

Village Radio may have an antenna for transmission over the air. It also may be directed by cable from its studio to the homes of its community, or radiate a few meters from electrical wiring or along a "leaky" transmission line. In some countries, one or more of these propagation methods may not require a government license.

Although a Village Radio station might vary in cost from less than $10 to more than $10,000, a more typical price range is between $200 and $2,000, depending on coverage, delivery system, and equipment selected. Such a system could be described as a low-power, low-cost, low-tech, self-contained radio station capable of being received anywhere in a geographic village community. In remote areas, both transmission and reception may be achieved independent of A.C. power mains, relying instead on water, wind, or solar energy.

As vital as equipment considerations may be, Village Radio is more a concept than a collection of hardware, more than radio scaled down to village size. Village Radio is a tool for the self-development of peoples, a tool for sharing, participation and interchange. In short, Village Radio is a powerful tool for communication, where people can air messages of significance to themselves and to their community.

In Village Radio, the messages are much more important than the specific medium: messages sharing greetings, announcements, music, traditions, market prices, weather bulletins, health alerts, community consultations, news and other items of interest.

VILLAGE RADIO SOUNDS

Village Radio is a reflection of the community it serves, a village in communication with itself. It is a monitor of community life, pulsing with its seasons, festive occasions, sadnesses and joys. Its sound is uncomplicated, sincere and natural, with an oral, conversational format most likely.

Village Radio often serves as a voice of consultation, a clearinghouse for ideas, attitudes and points of view in the community. In this way it helps the villagers arrive at a common vision for various aspects of community life and development. Radio can aid this process by providing microphone access to all who wish to be heard, whether singly, in panel discussions, or in "town meetings" open to all.

It may also have a spiritual function, imparting aesthetic experiences, religious ideas and personal values along with intellectual notions. Reinforcing traditional concepts of sharing, participation and fellowship, it can provide a living calendar of festivals, memorials, holy days, devotions and similar modes of common worship.

Radio can become a channel for the village's oral traditions, including stories, songs, drama and folklore. The elders can pass on their wisdom and that of their ancestors through this voice. Where radio is an integral part of the community, it is a natural reflection of village ritual, sharing festive occasions, hunting, planting and harvest activities, births, marriages, funerals and other rites of passage. In this context, radio becomes a part of the village, like its landscape, holy places and people.

Village Radio may also take on a dynamic spiritual component, serving as a frame of reference by which human endeavor can be checked and measured. In addition to the acquisition of personal virtues, such great themes as the oneness of mankind, the majesty of the Creator and essential harmony of all His messengers can be considered and discussed as powerful and guiding inputs to the village consultation process.

Virtually everywhere, Village Radio plays a key role in the communication of messages, greetings and announcements - from person to person, family to family and so forth along a vast multitude of paths.

Another Village Radio function might be termed "educative," where education is communication: acquiring, sharing and transferring human knowledge from one generation to the next. If radio is designed to facilitate communication, it will naturally enhance education: stimulating interest in cultural heritage, assisting the development of communicational skills, and providing a framework where learning is viewed in the larger scheme of individual, community and human progress.

Village Radio stations inform as well: telling the community about local events; announcing upcoming activities; giving time and weather information; warning of an approaching typhoon or possible disease epidemic; advising about the effects of a drought or flood; and listing preventative measures that can be taken.

Since Village Radio strives to be part of a community's existence, live coverage of sports, social events, tribal councils, field interviews, music and cultral happenings are apt to form a major part of its daily routine. Market reports are another good example of informational content. Today's price of coffee may be vital, not only to the villager buying next week's supplies, but as well to the farmer who must decide whether to bring the crop to market.

Village Radio also has a social function. This may include entertainment, but far more important to village life may be messages and greetings, or live broadcasts of events like feasts, dances, outings, sports and dramatic presentations. Play activities cherished by the villagers - games, jokes, funny stories, riddles - might also form a part of the station's social fare.

Then comes music, a force which can evoke fond memories, promote culture, stimulate the passions or a higher vision inside of almost everyone. Since each community's radio is a unique mix of these and other program ingredients, no two village stations are likely to sound the same, now or in the future.

VILLAGE SOUNDS DEPEND ON THE VILLAGE

In the Pacific Basin, many countries have stations serving the needs of village communities, and more are planned for the immediate future:

In Alaska, Canada and the United States, "native radio" models abound. For example, Wawatay ("Northern Lights") is a group of stations operated by the Native Communications Society in northern Ontario as part of a community development network. The stations serve 20,000 Indian people living in 40 isolated reserves and settlements in northern Ontario. The society began in 1973 to help indigenous people in the region to "develop their communities according to their own culture, beliefs and vision of the future." Wawatay has assisted 23 communities to set up Village Radio stations utilizing 1/2 watt FM transmitters to broadcast local news, weather, music and features of community interest in languages native to the region. (1)

From Porcupine Butte, South Dakota, Milo Yellow Hair awakens the Sioux each morning with the Wakaipi show - literally, "to warm you up" - on KILI-FM. The broadcasts are in Lakota, and the station bills itself "voice of the Sioux Nation." Not all village stations are tiny: this one radiates 100,000 watts from the Pine Ridge Indian Reservation to Sioux listeners scattered over hundereds of miles. Programs are in English as well as Lakota: only 60,000 people now speak the native tongue, but the station is teaching it to youngsters all over the area.

Other programs include "Rumor Control," which gives voice to the week's "newsmakers and troublemakers"; "Swapshop," a radio trading post; job announcements; and music varying from rock 'n roll to traditional songs and drumming. "We are not alternative radio," says station manager Hobart Yankton, "we are the radio." Most of KILI's 20 announcers are volunteers, working for gasoline money and love of the job.

Yellow Hair plays traditional songs that he has recorded at dances, gatherings and in people's homes, sometimes in honor of a veteran or an exceptional student: "You can't see them, but they are out there standing up. I keep an image in my head of an older man, like my grandfather, sharing someone's sorrow, playing music and making someone's life wiser." (2)

Not all indigenous radio stations in North America are focused on Native Americans. WLGI serves a rural black American population from the Louis Gregory Institute in Hemingway, South Carolina. Besides musical fare including jazz, gospel and rhythm & blues, the station features news of local happenings and uplifting messages of fellowship and brotherhood.

WMRF in West Orange, New Jersey is "Senior Citizen's Radio," broadcasting closed-circuit in the Daughters of Israel Geriatric Center. Residents have chatted on the air and played programming uniquely directed to their own interests since 1982. Program fare includes sports, interviews, music, and shows that senior citizens enjoy, such as reruns of "The Lone Ranger," "Amoz and Andy," "Fibber McGee and Molly" and "Fireside Chats with Franklin D. Roosevelt." Average age in the community: 84 years young!

Residents receive WMRF on 840 kHz AM, but a block away the station cannot be heard. The reason is that it broadcasts "carrier current," utilizing the campus's electrical wiring as a limited-radiation antenna. As a consequence, the station may operate legally in the United States without a license from the government. (3)

Literally hundreds of college campuses in North America enjoy similarly contained Village Radio models, operating carrier current on unused portions of the medium wave AM band.

One of the earliest exmples of community radio anywhere, the 5 "KRAB Nebula" stations (KRAB Seattle, KBOO Portland, KDNA St. Louis, KTAO Los Gatos and KCHU Dallas) were considered quite revolutionary in their heydey between 1962 and 1977. Theirs was "free forum" radio of the kind still practiced by Pacifica and other groups, serving a village of people without a niche in existing media.

In one of KRAB's earliest two-week periods on the air, no less than 55 community members, in addition to the station's volunteer staff of 12, appeared on-mike:

"Fifty-five persons, with fifty-five different views. We were delighted that there were so many, and wished that there could be hundreds more - for we see radio as a means to the old democratic concept of the right to dissent: the right to argue, and differ, and be heard...."

From Milam's delightful account of those days, "KDNA was fearless and magical. It returned the community to the radio studio, it opened its doors to the poets, the musicians, and political freaks - the dispossessed and longing who had been in their seedy rooms too long, waiting for someone to come along and spring them from their isolation. KDNA was radio reversing itself: asking that the people who lived in a city bring the city into the radio station, and cascade it out to the far reaches of men's minds and the horizon...." (4)

Radio Baha'i. In four countries of Latin America with Pacific coastlines, Baha'i community radio stations continue to break new ground. Radio Baha'i operations in Panama, Ecuador, Peru and Chile serve diverse indigenous populations from Guaymi, Otavaleno, Quechua, Aymara and Mapuche cultures, as well as Spanish-speaking latinos in each area.

Baha'i stations, like operations steered by tribal councils, have a participatory, consultative local management team who decide upon specific guidelines to encourage culture, music, dance, art, folklore, language and tradition as important and necessary contributions to the body of human experience.

Radio Baha'i attempts to appeal to the whole human being. The program mix includes folkloric music indigenous to the area and classic to the culture, whether rendered on high quality records and tapes, recorded in the countryside, or performed live by bands and singing groups travelling on foot for two days to the station, as they do every Saturday on Radio Baha'i de Bolivia.

The stations not only invite the participation of their audience, but participate themselves in events such as the Nucanchi Tono ("our music") festival in Ecuador. This annual event for both amateur and professional groups has become so popular that elimination rounds are held for weeks preceeding the two-day finale in Otavalo. Winning groups appear on television and record LPs and cassettes.

At an activity commemorating the station's anniversary in Ecuador, the mayor of the host town said, "What tribute can I pay to Radio Baha'i? Perhaps the best tribute is to say that it has become a vital and permanent institution in our community; I cannot imagine Otavalo without Radio Baha'i." In Peru, when Radio Baha'i del Lago Titicaca went off the air for a week due to diesel generator failure, a group of rural people protested, thinking that the station's license had been revoked.

In virtually every audience survey, these stations have emerged first in listenership, often far surpassing the next station in line. This popularity is probably attributable to two distinct features: a concern with the whole human being - with the heart as well as the emotions, the human spirit as well as the mind - and through the active participation of the people served. (5)

Radio Baha'i de Panama has two studio-office complexes. One is just off the Pan American highway a few miles from the city of David; the other is high in the mountains in the center of the Guaymi reserve. Both studios are on the air daily: at Boca del Monte utilizing electricity from intercity mains; signals are microwaved from Soloy using battery power charged by a photovoltaic solar panel. Sister station Radio Baha'i de Chile will soon have backup power from a 2 kW Jacobs wind turbine. (6)

Across the Pacific, Village Radio exploded for a few years with Japan's "mini-FM" movement. In 1981, after noticing that Japanese law allowed very low power FM transmissions without a license, Professor Tetsuo Kogawa and some students set up 1/10 watt Radio Polybucket at Wako University in Tokyo. Literally thousands of stations followed for the next few years, gradually subsiding as people came to realize that even a micro-station requires time and effort to maintain on the air.

The most successful survivors are typified by Setagata MaMa, located in South Tokyo in a small health food store and juice bar. From a well-tuned antenna, a 1 kilometer diameter area can be covered, translating into 10,000 or more people in the middle of Tokyo. According to Kogawa, the station's studio is an open microphone in the shop, serving as a gathering place for neighbors:

"This station is radically free from professional programming and has been open to anyone who wants to talk by radio. Even babblings, clatters, and slams in this store-station are on the air. One time, when several people began talking about community politics, some listeners rushed to the station and joined in the discussion." (7)

In addition to this "come in and talk" model reminiscent of the USA's KRAB stations, Village Radio in Japan has served as a voice for counter-culture, as "soapbox" for politicians, parties and others, as the voice of universities, neighborhoods and other territorial communities in Japan, and even as commercial radio outlets where chains of micro-stations are linked together, typically as alternative pop music channels.

All over rural China, there exists a "hard-wired" local tier of radio programming, but this usually consists of the audio from regional services. Nevertheless, there is some interest in truly participatory Village Radio in the country at this time. Meanwhile, a university instructor in Nanjing, China and a literacy consultant in Massachusetts, U.S.A. have both successfully used Village Radio concepts in the classroom. From Robert Postlethwaite in Nanjing:

"Something surprising happened. We introduced a mike into the classroom today. Freshman English (Village Radio). It changed instantly! The atmosphere was changed. There was energy. People's personalities came out. One girl sang spontaneously. I thought she was shy and she blurted out a whole song.

"I changed. I felt more relaxed, more connected, felt natural and when I did not understand a question, I would ask. I'm sorry I did not do this sooner. We could have a whole unit, semester, using the radio - where they might write scripts, interviews, etc.

"My point, or my interpretation of this is that people unconsciously felt empowered. Our relationship changed - instead of teacher-student, we were together." (8)

In Fall River, Massachusetts, Literacy Specialist Jean Parenteau utilized a "toy" wireless microphone to promote reading and communication skills among special needs elementary students. The following excerpts are taken from a 2 July 1989 article on the subject in the Fall River Sunday Herald News by Jean Judge (p. E-1):

"Giving a voice to people who have never had one is pretty heady stuff. Whether they are adults in remote corners of Third World countries, or whether they are children in special needs or even regular classes right here, there is something special about taking a microphone in your hand and talking to 'your world.' Its all part of a concept called 'Village Radio' adapted at the Brayton Avenue School by Jean Parenteau.

"With an $8 toy mike, and some batteries, she helped put some 25 youngsters on the map in a program designed to promote literacy. Combining the concept of communication and literacy within the classroom community, it was the focus of a several-months-long project. What the little mike does is to amplify the children's voices so that they 'sound as though they were on the radio.' More subtly, it affords them the opportunity to share their work and their views.

"Janessa Carvalho, age 6, and Erika Medeiros, another first grader, read from their very own books about dinosours. They were presented by Nichols who interspersed his commentary with a riddle, before introducing second graders Scott Aubin, reading his own chiller, 'The Mad Scientist,' and Chris Silva, with his book, 'Slime.'

"To the reading specialist, the radio project revealed that as the children developed confidence, their ability to listen, as well as to speak, improved, which is an aid to their literacy development too. She also sees the project as one which is valuable in developing self-esteem, cooperation and social skills." (9)

PROPAGATION: TECHNICAL AND LEGAL POSSIBILITIES

AM OR FM BROADCAST. For obvious reasons, most community radio stations the world over fall into one of these categories. With the exception of such micropower models as 0.1 watt "mini-FM" in Japan, virtually all such stations require government license. Options available include power levels from less than 50 watts to more than 50,000 in some places, with coverage areas varying according to radiated power, terrain, frequency, antenna type and so forth.

BIG RADIO, LITTLE RADIO. Open broadcast radio transmissions obey certain laws regardless of scale. Every tenfold increase in power out of the antenna, for example, will yield about twice the radius of coverage (and four times the area, proportional to r^2) Put another way, the difference between a 10,000 watt and a 100 watt AM station (besides $100,000) is a radius of coverage about four times greater for the former. This has important implications for Village Radio, where a few kilometers' coverage might be quite sufficient to serve a community.

On AM even a relatively unsophisticated tuned wire antenna can be utilized in conjunction with a 10 watt transmitter over flat terrain to achieve a coverage radius up to 20 kilometers. Moreover, the same penetration can be achieved from as little as 1 watt of transmitter power from a well-designed vertical mast antenna. Likewise for FM, where 1 watt might suffice to serve a small community from a pole-mounted antenna in its center, and 10 watts can provide coverage to even a moderate town.

MICROPOWER, on the other hand, is defined here as any level less than 1 watt. Japan's "mini-FM" stations fall into this category, with 100 mW (0.1 watt) of power, as do 1 mW wireless microphones and 100 mW input unlicensed AM transmitters in the United States. Where such devices have mention in communications regulations, their radiation is often further restricted by field strength limitations, maximum antenna length, and similar constraints. Where legal, micropower transmitters may serve needs such as classroom and city block radio (above).

RESTRICTED RADIATION. In this category, conventional antennas are taboo. While transmitter power is often in the 1-25 watt range, only very local reception is permitted. One such system is carrier current which injects radio frequency energy into the electrical wiring of a building or campus (see WMRF above). The radiation from such an "antenna" follows different propagation rules which keep it contained to a small distance from the wiring, varying inversely with d^3 instead of d^2

Moreover, the r.f. energy on the power mains is stopped by the first power transformer it encounters, limiting its effectiveness to the secondary side of a single distribution transformer.

Another restricted radiation system which follows the same $1/d^3$ law is called leaky cable radio. Under defined circumstances, such systems have been used without license on the AM band in the United States to broadcast messages to tourists travelling down a highway where a special "leaky" coaxial cable is buried or suspended. This concept can be applied to a small village, where a mile of leaky cable radiates local radio signals to homes up to 40 or 50 meters away. Additional lengths of cable require multiple cable drivers or linear amplifiers, utilizing a 20 watt unit for each mile.

CABLE RADIO. This alternative does not radiate at all; instead, small amounts of AM or usually FM radio signal are conveyed by cable directly to receiving sets in the community. While a broadcast license is not normally required for cable radio, in most places it is franchised or otherwise regulated by government.

Wired Audio Systems. One subset of wired radio is the "wired speaker" model so prevalent in China (above). Here listeners have not a radio but rather a speaker, usually with "L" pad volume control. High power, relatively high voltage audio is distributed directly to each receiving point. In still another scenario featured in India, Peru and Mozambique, village "stations" feature pole-mounted speakers, radiating sound directly to the listeners (whether or not they desire the "service").

THE FUTURE

Village Radio is taking hold, in the Pacific Rim and elsewhere. As this paper is written, plans are afoot for small community development stations in Tonga and the Solomon Islands on one side of the Pacific, and several Central American possibilities exist on the other. In the Philippines, a Baha'i radio station may soon become reality in rural Luzon, while Palawan projects island-wide coverage from a string of low power stations in the years just ahead.

SOME PREDICTIONS

1. Village Radio stations will proliferate, responding to the special needs of "village" communities bound by tradition, culture, need or territory.

2. Models will become increasingly participatory, serving as channels for the sharing of ideas, concepts, information, messages, and greetings - in short, as means for human communication.

3. As they become communication channels, Village Radio systems will facilitate new and higher levels of democratic administration of and by those served as opposed to governed. The hallmark of these systems will be free and open consultation by the people concerned, focusing upon their own development as well as that of their neighbors and the world community.

4. Science will provide the means for the communication of development, including low-cost, user-friendly studio and transmission equipment; independent energy; methods and equipment for linking stations in neighboring communities; and other technology appropriate to the enhancement of communication among the dwellers on our small blue planet.

REFERENCES

(1) WAWATAY Native Communications Society. "Community Development Through Communications" pamphlet. Sioux Lookout, Ontario, undated.

(2) Rocky Mountain News staff. "Radio Works as Sioux's Cultural Hookup." Denver: Rocky Mountain News, May 9, 1988.

(3) LPB staff. "Senior Citizen Broadcasting" Application Note. Frazer, Pennsylvania: LPB Inc., 1983.

(4) Milam, Lorenzo Wilson. The Radio Papers. San Diego: Mho & Mho Works, 1985.

(5) Stephens, K. Dean. "Community Radio Models: A Review of Technology, Organization and Philosophy." Paper for Beijing International Conference and Exhibition on Radio, TV and Cable, published in Conference Record Beijing 1990.

(6) ___________. "Alternative Energy for Radio Stations." Development Communication Report 87/3.

(7) Kogawa, Tetsuo. "Free Radio in Japan." Cultures in Contention. Seattle: The Real Comet Press, 1985.

(8) Postlethwaite, Robert. "Classroom Village Radio in China." Vanguardia 3:4, Oct 1990.

(9) Judge, Jean. "Brayton Avenue School Students Take to Air Waves." Fall River, Massachusetts: Sunday Herald News, Jul 2, 1989.

NOBLE HOUSES SATELLITE AND CABLE - HONG KONG 1990, AND OTHER REGULATORY ISSUES

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ABSTRACT

The award of Hong Kong's first cable TV franchise, the proposed deregulation of SMATV systems, the launch of AsiaSat and the start up of the territory's first satellite TV broadcaster, took place all within eight months of each other. It provided the recipe for an explosive debate which for some months derailed the Government's stated deregulation plans. Upon the decision of Government to permit satellite TV programme to compete via SMATV systems with cable TV, the cable franchisee withdrew. Government now looks poised to resurrect the cable TV issue.

1. INTRODUCTION AND BACKGROUND

"You could say a battle of the titans was brewing in Hong Kong, pitting Y.K. Pao's Wharf against Li Ka-shing's Hutchison. Or it could be called a battle of the new technologies: cable against satellite." (1)

When the abstract for this paper was submitted last year, the proposed title and intended paper were not quite the same. It had begun, "Noble Houses Satellite or Cable? ...". The analysis of the anticipated end of the volatile, but occasionally forebodingly silent, debate going on in Hong Kong between the two Noble Houses was going to have to wait until the latest day possible. But, before the date speakers were required to finalize their papers, the unthinkable had actually happened, the Noble House of Cable had unfolded.

Despite what you might think, the collapse of the cable TV consortium, has not substantially changed the fundamental telecommunications and broadcasting issues with which the Hong Kong Government must come to grips. In fact, the irony may well be that it was only the demise of the original cable consortium which could force Government to focus more clearly on its sights. We shall look more closely at the 6-month debate in which "SMATV" became a household word, and which regularly put telecommunications policy in the morning headlines - something of a feat anywhere let alone in stock market-oriented Hong Kong. But first, we need to understand something of the nature of Hong Kong and the evolution of the Hong Kong cable franchise concept.

1.1 THE EVOLUTION OF THE CABLE FRANCHISE CONCEPT IN HONG KONG

The cable TV concept in Hong Kong was actually proposed by the local voice monopoly, Hong Kong Telephone Company Ltd ("HKTEL") about 6 years ago, so that it could run a small cable service in an area of Hong Kong. This prompted Government to seek an extensive report from consultants, Booz Allen Hamilton, which recommended the introduction of cable TV. But far more importantly, they also recommended the building of a second wire network.

The tender for cable in 1988 therefore sought the development of more than just cable TV. A second telecommunications network was a key feature in Government's sights. In view of HKTEL's local voice monopoly expiring in 1995, the opportunity to own and run such a network became the real carrot to the bidders. Not long after the tender was opened in September 1988, HKTEL, who along with other interested bidders had been preparing to submit a proposal, was forced to pull out. Government insisted that its policy was of future deregulation and that the monopoly could not carry a cable TV service as well as be the local telephone franchisee.

The field was therefore well and truly open for a new network operator from 1995, and for the building of purportedly the world's largest cable network (at least 1500 kilometres of cable was to be laid).

1.2 TRADE AND TECHNOLOGY HAND IN HAND

Technology and trade is the name of the game in Hong Kong. This is well recognised by local entrepreneurs like Sir Y.K. Pao, leader of the Wharf Group and of the now defunct cable consortium, and Mr Li Ka-shing (often quoted as the wealthiest and certainly one of the boldest Hong Kong entrepreneurs), leader of the Hutchison Group ("Hutchison") and of the satellite TV broadcasting company.

"We can all talk about how ... television will promote democracy .... and bring information ... and enhance freedom. But all of that is irrelevant if we can't make money". (2) And so it was for both the business-minded Hutchison Group and Wharf-led cable consortium.

1.2.1 Hutchison had all along been the hot favourite to win the cable TV franchise. It had spent 3 years preparing for it. By contrast, the consortium later to be known as HKCC, was far less prepared. But in the wake of June 4, and in the final days of presentations by the major two bidders, Government called for a higher monetary commitment of up to HK$5.5 billion (about US$701.1 million). Government also advised the parties its intention was to deregulate television receive only ("TVRO") dishes and satellite master antenna ("SMATV") systems. Hutchison purportedly refused to make the requested monetary commitment and the franchise was awarded to HKCC.

It is difficult to pinpoint exactly the hidden agenda of Government. Did the apparently unstoppable Hutchison, which already had a large finger in several telecommunications pies, need to be shown that it could not have everything it saw and wanted? Or did the Government give Hutchison a face saving out? There seemed to be at least a hint of the former, which gave the local press its start in the development of the newsworthy theme of personal antagonism between members of the Noble Houses, throughout the debate in 1990. (But whatever anyone's agenda had been, Government ultimately changed sides a year later and the "Hutch boys" have certainly had the last laugh.)

1.2.2 A consortium comprising local heavyweights Wharf Holdings (28%), Sun Hung Kai Properties Ltd. (27%) and Shaw Brothers (10%), and international Coditel (10%) and US West (25%) in August 1989 became Hong Kong Cable Communications Limited ("HKCC"). The award on August 1, 1989 was for a licence of 15 years: to transmit TV and sound programmes by wire on an exclusive basis for the first 6 years; and to carry non-franchised telecommunication services on a non-exclusive basis.

1.2.3 Hutchison Whampoa Limited, Hong Kong's third largest company, had a grand scheme for satellite TV for Asia. As a one third owner of AsiaSat with Cable & Wireless plc and China International Trust and Investment Corporation ("CITIC") (a Hong Kong based investment arm of the PRC Government), it achieved the launch in April 1990 from the PRC. It also owned HutchVision Limited ("HutchVision") which reserved 12 of AsiaSat's 24 transponders, to implement Hutchison's plans of creating a pan-Asian television system. HutchVision's target was a pan-Asian audience, and local-niche groups of expatriates and English speaking people in Hong Kong. Its main source of revenue was to be from advertising, with TV channels to be free of charge in the initial phases. Based on a budget in excess of HK$3.1 billion (about US$400 million) it proposed seven 24-hour channels beaming down on countries stretching from Japan to India (covering some 35 countries), broadcasting international news, sports, music and general entertainment programmes.

1.2.4 Government encouraged the simultaneous double package of cable and satellite TV via third party SMATV systems. Hong Kong's high density of residential high-rise buildings permit SMATV systems to be installed to maximum advantage, and as with anywhere far more quickly than a large cable network. No businessman would therefore be interested to build a large cable TV network without some form of protection or assurance that the business would be able to operate viably. Government regarded that protection to HKCC as the 6 year exclusivity period. HKCC accepted that it was going to be almost 1997 before it would get any payback for its massive investment.

Satellite TV, which had not been in HKCC's mind at the time of the cable bid, on the other hand, was going to be cashing in on the AsiaSat downlink a long way before 1997. This was so long as the Government followed through with its statements in 1989 that the law would be changed and SMATV would be permitted.

And this is what the debate was all about. Could each of the Noble Houses make the money they had envisaged?

As to whether Government would permit SMATV or not were seen as the goal posts for each side. For almost 6 months, Government did an extraordinary trapeze act, so that neither side could be certain which way Government would go. To draw an analogy, it was like many old Chinese marriages. The husband decides to take on a concubine, hoping that she will happily co-exist with the principal wife and live under the same matrimonial roof. The Hong Kong Government, like the master of the house, tried to accommodate both cable TV and satellite TV and apparently took great pains deciding which one to spoil. As an appeasement, the master of the house made promises to both sides that changes would be made in their favour, but never commitments.

On August 1, 1990 (exactly one year after the cable award), the go-ahead was given by Government for the law to be changed and SMATV licensing procedures to be implemented. After 2 more months of all the parties - including the Government - slugging it out, on October 31, 1990 specific satellite TV and SMATV licensing conditions were made public.

Soon after, HKCC announced it was leaving the master of the house.

1.3 HONG KONG'S REGULATORY ENVIRONMENT

Locally, HKTEL has the exclusive right, until June 30, 1995, to operate public telephonic communications by wire in Hong Kong (under the Telephone Ordinance). Internationally, Hong Kong Telecom International Limited ("HTI") has the exclusive right until 2006 to operate by wire and wireless means, public and private, international voice, data, image and video telecommunication services (under its exclusive licence from Government). Both HKTEL and HTI are subsidiaries of Cable and Wireless plc.

Hong Kong has a well-deserved reputation for hi-tech innovative communication systems (with 600,000 pager users - one tenth of the population, and 104,000 cellular phone users, with that number expected to double by the mid 1990's). Despite this, neither the telecommunications nor the broadcasting legislation addressed the issues relating to cable TV, satellite TV, SMATV systems, or clearly address the issue of single dwelling TVRO apparatus.

1.3.1 Without an appropriate licence (under the Telecommunication Ordinance, ("Ordinance")) a person cannot establish or maintain any means of telecommunications in Hong Kong, unless he falls within an exemption within the provisions of the Ordinance (namely, Section 8(4)).

o As at the date of the cable award, the Ordinance provided exemptions in respect of a "television receiver", which was undefined, and community antenna systems receiving TV signals of the 2 local off-air TV broadcasters.

o In January 1990 Government circulated a draft amendment to the Ordinance. It sought to amend the exemption provisions by defining a "television receiver" to include single TVRO dishes, and by replacing the community antenna provision to cover distribution systems receiving both local and satellite transmitted TV programme signals. (In substance, it had most of the same component parts as found in Section 602(6) of the U.S. Cable Communications Policy Act of 1984).

  It was the wording in the distribution systems provision that really sparked off HKCC's objection. HKCC's argument was that SMATV systems were in effect small cable systems, which should be within HKCC's prerogative. Of particular concern to HKCC, was the Government's imprecise drafting that was designed to give effect to its intention to limit the exemption to certain systems i.e. "non commercial" systems, within a defined set of premises which were permitted to receive signals only "intended for general reception".

o The reception and transmission rights for TV and sound programmes into and out of Hong Kong rested with HTI within its exclusive licence rights. These rights however were (and still are) expressly stated to be subject to any decision of the Governor in consultation with the Executive Council (the policy rather than law making body in Hong Kong). Such decision may permit other persons the privilege of either or both of these downlink and uplink rights.

1.3.2 As at December 1, 1990, as a direct result of the satellite TV/cable TV saga, the regulatory changes that had been effected were:

o The granting of express permission to prospective SMATV and satellite TV licensees to downlink and uplink respectively without infringing the rights of HTI.

o The Ordinance was clarified to confirm that a TVRO connected only to a single TV set was exempted from licensing, but that a SMATV system was not exempted and will need to be licensed. The draft Regulations embodying the new form of SMATV licence and all its conditions are not expected to be finalised until mid 1991 by the Executive Council. (These are presented in 3.4.1 of this paper.)

o The new form of licence permitting satellite TV uplinking/broadcasting from Hong Kong will be created under the legislation (but it was not clear if it would be under the Ordinance or the broadcasting legislation or both.)

2. THE SATELLITE TV/CABLE TV DEBATE

2.1 POST-AWARD

The award of the cable franchise had been granted on August 1, 1989.

It was not until AsiaSat was launched in early April 1990 that the first shots were publicly fired. Hutchison announced its reservation of 12 of AsiaSat's 24 transponders (6 for each footprint) for the 6-channel HutchVision service to be beamed into Hong Kong and the rest of Asia from AsiaSat. Coming on the back of the proposed deregulation of SMATV, the public war between cable TV and satellite TV programming began.

2.1.1 One thing was certain, the laying of HKCC's network meant that satellite TV programmes via SMATV systems would be capable of being delivered to homes at least 1 year before HKCC could launch the first of its cable TV services. HKCC claimed satellite TV programmes posed a serious threat to the viability of its business, and that Government had undertaken not to seriously jeopardize HKCC's immense investment. HKCC's argument was not directed at AsiaSat or satellite TV as such, but rather the prospect of third party SMATV systems which it claimed were in fact small cable systems, and therefore infringed HKCC's exclusive franchise.

2.1.2 Hutchison's argument was that the cable TV bidders had been warned immediately prior to the award that deregulated TVRO and SMATV would be part of the operating environment. It further claimed that its satellite TV service would not jeopardize HKCC's cable business. HKCC was required under its franchise to provide at least 10 channels. HKCC had undertaken that these would principally be locally produced Cantonese language programming (as well as imported English language films, sport, educational services, community broadcasts and minority interest TV), targeting as subscribers 60% to 70% of Hong Kong people - of whom about 98% speak Cantonese as their native language.
Satellite and cable operators had worked together in other countries, why not in Hong Kong?

2.1.3 Both parties lobbied Government furiously from May through July 1990. On August 1, 1990, the Executive Council made the first of 2 formal policy decisions on the issue. Government's announcement was a classic compromise between deregulation (of TVRO's) and new regulation (for SMATV licensing). It gave neither party an outright victory, no clear promise of what or when licensing regulations would be drawn up, or whether the cable franchisee would be protected against such TV programme competition.

The game of brinksmanship between the Noble Houses escalated and Hutchison's magnificently oiled publicity machine dealt a masterful blow. In an open letter to all its shareholders in the local newspapers on August 15, 1990, Hutchison simply stated that it might have to abandon its plans for the satellite TV service if the regu- lations concerning a broadcasting licence were too restrictive, or if there was a delay in the introduction of the regulatory framework for satellite TV. It added that "The Company is extremely grateful for the public's support." The front page news story was that Hutchison was being forced to reconsider its multi-million dollar leasing option, due to expire at the end of 1990, for half of AsiaSat's 24 transponder capacity. The message was clear, if necessary Hutchison would simply move its satellite TV operations from Hong Kong to somewhere else in Asia. (3)

At the same time, HKCC also let it be known it would pull out if it did not receive from Government a guarantee of no-SMATV. But HKCC had left itself open to attack by its apparent lack of any programming or construction of the network in the year since it had been awarded the franchise. The Government and the public were losing patience.

Both the parties pressed the Government for some definitive guidelines for SMATV and satellite TV. More furious lobbying. The local press summed it up thus: "The affair is too muddled to blame on any one party. The current deadlock is a complex mix of archaic local broadcasting legislation and fumbling attempts to update it. Throw in a consortium whose members' aims lack unity, Hong Kong Telecom's vocal resistance to a second telephone system and a dash of black propaganda amongst business rivals and you get an almost insoluble mess." (4)

2.2 THE FINAL BLOW

It was clear that on the one hand, when HKCC had in 1989 made its commitment of HK$5.5 billion, Government was grateful for the positive business support in the wake of June 4, and gave HKCC the franchise. It was also clear that on the other hand, by 1990 Government very much wanted to keep AsiaSat and HutchVision as Hong Kong based, home grown concepts.

On October 31, 1990 the Executive Council announced its second formal decision on the subject of satellite TV. It claimed it "was alive to the need...to be equitable to the interests of [all] television services", i.e. cable TV, satellite TV and as well, the 2 existing off-air broadcasters, TVB and ATV. The press release set out the specific conditions to govern satellite TV and SMATV licensing. But it was made quite clear that the House of Cable simply would have to pull itself together - unaided any further by Government - as best as it could. The Executive Council "favoured developing Hong Kong as a base for uplinking satellite television programming for an audience principally outside Hong Kong. This would enhance Hong Kong's global and regional image." (5) Just one year after June 4, the Government was now grateful for the commitment of Hutchison.

2.2.1 From Hutchison's point of view, it was then confirmed that HutchVision would get the territory's first satellite TV broadcasting licence. It would also get the very valuable right to bypass HTI's uplinking facilities and establish its own earth station to transmit programmes via AsiaSat. Additionally, there was nothing preventing HutchVision, or at least a related Hutchison company from also applying for a SMATV licence.

2.2.2 From HKCC's point of view, it was confirmed that virtually all the original sins of SMATV remained from the earlier proposed amendments to the Ordinance. Thus it would still be possible for a SMATV operator, in return for a fee not classified as one for satellite TV programme subscription, to wire a single block on one estate having "private" roads thus joining anything up to thousands of dwelling homes in Hong Kong's unique high rise environment. Additionally, the satellite TV broadcaster was only to be restricted from broadcasting Cantonese language programming, but not programmes of other Chinese dialects or Mandarin, and only for the first half of HKCC's 6 year exclusive period.

On November 17, 1990, the House of Cable announced it would pull out.

3. IMPLICATIONS OF THE DEBATE ON FUTURE TELECOMMUNICATIONS AND BROADCASTING POLICIES

With the House of Cable no longer on the playing field, there was an initial flutter of speculation. Did Government still need or want to maintain its stance on various issues: SMATV licensing conditions? the 3 year prohibition on satellite TV broadcasters transmitting programmes in Cantonese? or on the prohibition on HKTEL from providing cable TV services over its network? At the time of writing, Government is playing its hand close to its chest. It intends keeping all its options open to woo back onto the field another party to complete the team line-up of satellite and cable TV broadcasters and second network operator.

3.1 GOVERNMENT'S ROLE

3.1.1 The Government has been repeatedly criticised by all parties with an interest for its apparent "inspired inaction" up until the very last hour. Did the appearance of such inaction arise because some of the Government departments involved were not adequately armed with the requisite knowledge of communications technology or sufficiently exposed to normal business and financial practices? After all, there were 3 departments involved: Recreation & Culture (on broadcasting), Postmaster General (on telecoms) and Economic Services (on policy). Certainly Government people were engaged in fact-finding action. But perhaps the whole process suffered from "perpetual drag" each time a new report was required for the process of liaison and agreement with all the internal committees involved.

To an outsider, there did not seem to be an unwavering vision of pursuit of a balanced policy portfolio, of all the ingredients necessary to put Hong Kong on the cutting edge - something Hong Kong could do with right now.

3.1.2 As at the time of writing, yet another Government report seems imminent. A post-mortem on cable's collapse is intended to identify the strengths and weaknesses of the evolution of the satellite TV/cable TV battle, rather than present a constructive self-analysis. Its aims will be apparently:

- to compile a list of requirements that should be imposed on any future cable franchisee to ensure performance of the contract with Government no matter what the operating environment, (i.e. a performance bond may be required to stay on track with programming and construction schedules).
- to try and assess whether or not such a franchise should include the right to provide certain telecommunications services and the prospect of the second telecommunications network. (i.e. Should interested parties be geared up for a gamble on deregulation and not expend "psychic energy" on the possibility of the post 1995 prize?). Government has stated that it is "undiminished" in its commitment to have a second network provider. On one hand, it concedes that for any cable TV franchisee, the real and only prize would be the right to the second network but it seems reluctant - yet again - to reveal its future plans for HKTEL after its franchise expires.
- to provide the basis for a report and revised recommendations for the way forward, to be submitted to the Executive Council in January 1991, with a view to a new cable tender situation.

3.2 EXPIRY OF HKTEL'S FRANCHISE, 1995

"....Competition in fixed networks is passe" (6) were the recent immortal words of the Chairman of Cable & Wireless plc, Lord Sharp, made at just about the same time as HKCC's demise. He suggested, as Government saw its second network slipping away, that HTI could help everyone out by HKCC leasing HKTEL's network for a cable TV service. After all, he said, HKTEL had room enough for two - cable and voice that is - even after 1995.

3.2.1 In spite of HKCC's pullout and HTI's recent offer to lease its existing network to distribute cable TV, Government appears still keen to exclude HKTEL and HTI. And the second network for telecommunications is still the prize eyed by interested parties, even if it means bidding (again) on a 2-in-1 package via a cable TV tender. But Government has not been forthcoming as to when it will announce what it has in mind for post 1995. Everyone - including HKTEL - is still claiming to be in the dark. Given the long drawn out evolution of a cable policy, Government could easily take its time as it is still 4 years away from the expiry date, and continue to compile internal reports.

However, clearly, if Government intends to make suggestive movements regarding the possibility of voice with cable, it needs to remember it is now 2 years closer to the expiry date than the last time it played this game. This time, with satellite TV and SMATV already in existence, any new cable company is unlikely to have as its agenda anything less than a voice duopoly with HKTEL.

3.2.2 There is another new player who has emerged since the HKCC cable award. CITIC, the PRC investment company, now 20% shareholder in HTI. CITIC is reported to be "very concerned" about the possibility of a second network, and like HTI is also putting its proposals to Government.

Thus we now have 2 substantial players, HTI and CITIC, who each has a large vested interest in maintaining the status quo after 1995, and above all in preventing the construction of another network. Any interested network provider will have to contend with their combined lobbying forces.

3.3 MARKET CONFIDENCE SINCE JUNE 4, AND 1997

3.3.1 Against the background of 1997, Hong Kong is threatened by immediate problems of brain drain and shortage of labour. Yet it remains one of, if not the region's most reliable and cost-effective communications base.

"...Like everything else in Hong Kong everything must be put through the countdown-to-1997 litmus test: How will Beijing react? How will the Government's balancing act between satellite and cable affect business confidence? Will the cable troubles make the Government lose face?" (7)

HKCC's pullout immediately affected the share market performance of the key players - they went up! Analysts believed that both HTI and Hutchison would benefit from the reduced competition. Wharf Holdings and Sun Hung Kai, 2 of the major HKCC consortium members, were also expected to benefit because investors had been concerned about the viability of the cable project. (8)

3.3.2 The PRC is no doubt getting more involved in Hong Kong matters but the 20% acquisition by CITIC in HTI is still viewed equivocally. CITIC itself has a reputation for being a relatively entrepreneurial investment body, albeit a PRC one.

3.3.3 However of more concern are the broadcasting standards requirements concerning control and censoring of programme and advertising content. Government so far has not seriously tried to control the content of material broadcast by satellite into Hong Kong. No one can predict how in 1997 such issues will be treated.

3.4 REGULATORY CHANGE

Government has indicated that certain changes to the regulatory environment will be carried out in the early part of 1991.

The Hong Kong Government appears to have a penchant for borrowing bits and pieces from other countries' models, and filling in the gaps with something original to suit the local changing circumstances. The learning curve presented to Government by the satellite/ SMATV/cable debate should have in a lawyer's mind, led clearly to a complete revamping of the present framework. In some respects the broadcasting and telecommunication legislation (the Television and Telecommunication Ordinances) seem rather patchily put together, and the copyright provisions (under the Copyright Ordinance) are downright inadequate. But this being Hong Kong, Government has not chosen to overhaul it. Nor is it likely to.

The benefit of this approach - if it can be said to be so - is that Hong Kong's regulatory framework is unlikely ever to reach the complex levels of the U.K. or U.S. environments. The downside is that the process of legislative change is a very closed process in Hong Kong (there are no elected politicians and we have no regulatory watchdog). Thus the evolution of even minor changes can be hard for interested parties to monitor or to alter their course.

In any event, the Government is in the process of drafting 2 new forms of licences as a result of the satellite/cable saga.

3.4.1 The SMATV licence - Government does not expect this to be finalised and approved by the Executive Council until June 1990. In order to leave doors open for the return of cable, it is Government's intention not to allow SMATV licensees to provide or package programmes for distribution or to collect or charge subscription fees for a programme provider.

The other conditions will be:

- only to provide, install and maintain the equipment;
- to meet the standards of technical competence laid down;
- to provide adequate proof of good financial standing;
- not to take cable across unleased Crown Land or public streets;
- to distribute only signals intended for general reception;
- to install only equipment compatable with good quality reception of the licensed terrestrial broadcasters' signals; and
- to comply with any direction of the Governor in Council not to distribute through the systems it has installed programme services which the Governor in Council may designate as "proscribed" (i.e. not permitted for reasons of bad

taste, etc).

3.4.2. The satellite TV broadcast licence - Government is being pressured strongly to finalize this form of licence prior to the expiry of Hutchison's transponder options with AsiaSat. Government's proposed limitations on satellite TV broadcasters were aimed at being "equitable" not only to a cable TV operator, but also the 2 existing local off-air broadcasters, TVB and ATV. These conditions will be:

- not to finance its business through subscription in Hong Kong during the period of [a cable TV licensee's - originally it was specified as HKCC's licence] exclusivity;
- not to rely principally on Hong Kong's local advertising market if it finances its business through advertising revenues;
- not to broadcast Cantonese language programming, except after 3 years, at which time programmes in Cantonese previously broadcast in Hong Kong may be broadcast. Also, at that time the Government will review whether newly produced Cantonese language programmes may also be broadcast;
- to observe the provisions in the existing code of practice on television programme standards, except those related to time of broadcast;
- not to broadcast tobacco advertisements;
- to be a company incorporated and registered in Hong Kong;
- not to be a subsidiary of any other company; and
- to be majority owned by Hong Kong residents.

The rest of the conditions will be:

- to be responsible for ensuring that material broadcast by it does not infringe others' copyright, and for taking all reasonable steps to ensure the acceptability of its programmes in recipient countries;
- to comply with existing advertising standards other than those not appropriate to a programming service intended to span several time zones and containing advertisements of foreign origin; and
- to make payments to the Government calculated on a percentage of that portion of its revenue deemed to be derived from Hong Kong.

3.4.3 However, necessary and critical amendments to the copyright legislation have still not been passed. Instead Government has put the onus on satellite TV broadcasters to see to it that broadcast materials have not infringed another's copyright. This is an unsatisfactory stop-gap measure so long as a foreign broadcast work remains a non copyright work under a lacuna in Hong Kong's present law. At this time the only possible rights and obligations as to "copyright" in that sort of work are those contractually agreed between 2 parties, and are not enforceable against any other party. Government should be pushing very hard to have the law amended as soon as possible.

3.5 THE WAY FORWARD

3.5.1 While the local war was still in its last days, another cable alternative was proposed, allegedly unsolicited by Government - by a media and marketing research company, Legend Communications Ltd. It claimed it could bring cable to Hong Kong in less than half the time and at a fifth of the cost of HKCC's scheme. It proposed to divide the territory into 13 franchise areas, each averaging 120,000 households. Oddly, there has been no public response from anyone on this mysterious proposal. Since HKCC withdrew, there have been also other candidates - some apparently eminently suitable - who have submitted proposals to the Recreation & Culture Branch for cable TV operations.

It may be however, that a Legend - style proposal finds an ally in HKTEL and CITIC who both have very good reasons for not wanting to see the resurrection of a second territory-wide single network. HKTEL would also be needed to provide the interconnect services between the individual franchise areas.

3.5.2 It would not be an overly ambitious speculation to say to all those interested in becoming players in the Hong Kong market, that most probably:

- from early 1991, there will be the first satellite TV licensee;
- by late 1991, there will be the second cable licensee (with SMATV and satellite TV woven into the terms of that license);
- by late 1991, there will be many new SMATV operators; and
- by late 1993, cable TV will be in place and a second network contender will be on the horizon.

4. SUMMARY

The way the Government handled the satellite/ SMATV/cable dispute should raise worries about how future competing interests will be balanced, and how general policy intentions will be implemented into legislative form where "new" technology is involved.

The way forward could be quite simple if the total policy portfolio were overviewed and the correct legislation put in place ahead of any grants of licence. One can only hope that the Government is to learn from history, rather than condemn us to re- live it.

Those of you with an eye on Hong Kong as a place for possible investment will find in certain service areas, which are not within the franchises of either HTI or HKTEL, that there is a good deal of promising activity and innovative technology. This is evident as in late 1990, tenders were invited and bids submitted for a CT2, and second commercial radio operator. Invitations to interested parties were also given to submit proposals to Government on the introduction of a digital cellular licence (in addition to the 3 existing analog licences), and to apply for licences for SMATV operations and satellite TV broadcasting.

Amidst diverse opinion on the collapse of cable, all parties would undoubtedly agree that it is high time to "... strive for a better modus vivendi - Hong Kong, at this critical juncture, can afford no less." (9)

FOOTNOTES/REFERENCES IN TEXT

(1) "Far Eastern Economic Review", June 14, 1990, "Down To The Wire"
(2) "Far Eastern Economic Review", June 14, 1990, "Down To The Wire"
(3) "South China Morning Post", August 15, 1990, "Hutchison Warns Government Over Satellite Service"
(4) "South China Morning Post", October 12, 1990, "Cable All Tangled Up"
(5) Press Release, Executive Council Decision on Satellite Television, October 31, 1990.
(6) "South China Morning Post", October 28, 1990, "Telecom Offering Lease Deal To HKCC"
(7) "Far Eastern Economic Review", June 14, 1990, "Down To The Wire"
(8) "HongKong Standard", November 19, 1990, "Cable Pullout Tipped To Boost Some Stocks"
(9) "Sunday Standard" November 18, 1990 "Collapse of Cable TV Group May Hurt Hong Kong"

DISTANCE EDUCATION IN THE WESTERN PACIFIC: ACCOMPLISHMENTS AND FUTURE TRENDS

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1.0 ABSTRACT

The University of Guam is the only four year post secondary institution in Micronesia. As such, it has been involved in providing post secondary educational services to Micronesia as a whole since 1981. In 1985 the University began experimenting with distance education delivery systems. This experimentation led to the development of the two models described in this paper.

2.0 INTRODUCTION

The University of Guam was founded in 1952 as a two year teacher training institution under the Territorial Department of Education. In 1963 it expanded its offerings to four years and was placed under its own Board of Regents. Five years later it was renamed the University of Guam by the Territorial Legislature and began the development of a small number of graduate offerings. In 1972 the University was accorded Land Grant Status by the U.S. Congress.

Between 1972 and the present the University was granted autonomy by the Territorial Legislature in a number of different legislative acts, culminating in its present Charter passed in 1988. Since 1963, the University has been accredited by the Accrediting Commission of Senior College and Universities of the Western Association of Schools and College. (1)

Today the University offers baccalaureate degrees in 26 fields and master's degrees in five. It has a student body of 2,600 students from over 20 different countries. Its faculty numbers in excess of 170 faculty members of whom 60 per cent hold terminal degrees.

While the majority of the University's students come from Guam and the various Micronesian States (i.e. the Commonwealth of the Northern Mariana Islands, The Federated States of Micronesia, the Republic of the Marshall Islands, and Belau), increasing numbers come from the U.S. mainland, the Philippines, China, Japan, South East Asia, and Korea. The diversity of the University's student body and faculty provides a multi-cultural and international setting found in few U.S. mainland institutions of its size. (2)

3.0 DISTANCE EDUCATION AT THE UNIVERSITY OF GUAM

As the only four year post secondary institution in Micronesia, the University has recognized that it has a responsibility to serve the region as a whole rather that just the Territory of Guam. As a consequence, in 1965 the University began offering on site courses in the Commonwealth of the Northern Mariana Islands (CNMI). The success of this program led the University to establish the Off-Campus Program Center under the office of the Vice President for Academic Affairs in 1974. This office was renamed the Center for Continuing Education and Outreach Programs (CCE-OP) in 1988. (3)

In 1981 the University was approached by Pohnpei and Yap States of the Federated States of Micronesia (FSM) to begin offering on site courses in their jurisdictions as well. Since that time the University has offered over 350 courses throughout Micronesia. (4)

In 1979, at the request of the CNMI, the College of Education at the University began negotiations with regional governments to establish the Individual Degree Plan (IDP). The IDP established a process by which students not resident on Guam could earn a degree in education from the University of Guam.

The Program provided a contract between the student and the University detailing the courses that each student must take to complete the degree within a ten year time frame and assigning equivalencies for course work completed prior to the student's entrance into the program. Of the 124 credits required for graduation, 12 must be taken at the University's main campus on Guam. The remainder, including student teaching, may be taken on the student's home island by traditional or distance education delivery systems. By 1990 the College of Education had enrolled approximately 1300 students in its IDP program. The Colleges of Arts and Sciences and Business and Public Administration are presently studying the applicability of this program for their offerings in Micronesia as well. (5)

Providing on site education to Micronesia presented the University with a variety of logistic and fiscal problems. Of these the most crucial were the University's inability to provide year round instruction and a sufficient number of courses to allow the student to complete his degree within the ten year time period; and the high cost of supporting a faculty member on site within Micronesia. In order to resolve these problems, the University in 1985 began experimenting with distance education delivery systems.

The first experiment was conducted in Kosrae State of the FSM, utilizing the PEACESAT MICRONET Network's ATS 1 satellite. The success of this experiment led the participants to begin planning a second experiment in 1986. Unfortunately, the failure of the ATS 1 satellite forced the postponement of these plans until an alternate communication system could be developed.

In 1986 and 1987, after ATS-1 began its uncontrollable eastward drift, the University established a single side band radio network capable of reaching all of the jurisdictions within Micronesia. Concurrently, the wanning Trust Territory Government helped several emerging Micronesian States to establish similar systems. The Department of the Interior and the Federal Communications Commission assisted with licensing and Micronet was reestablished in January 1988.

To operate this system the University established the Telecommunications and Distance Education Operation (TADEO) within the CCE-OP. TADEO presently consists of a coordinator, a part-time technician, rotating Micronesian work-study student operators, and a distance education support faculty from the Colleges of Education, Arts and Sciences, and Agriculture and Life Sciences who have part of their load assigned to CCE-OP.

The creation of TADEO led to the University's second and third distance education experiments. The second experiment delivered a course based on Jacob Bronowski's The Ascent of Man video tape series utilizing a similar format to that used in 1985. The third experiment delivered an Agriculture/Home Economic's course, Extension *Program Development in the Pacific Basin*, to 89 participants on nine different islands. The experience gained from these experiments laid the basis for the development of the models described in Section 5.0 of this paper. (6)

4.0 THE DISTANCE EDUCATION AND TECHNICAL BASE

The University's Telecommunications and Distance Education Center was established by the Office of the Academic Vice President in 1989 and 1990. The assigned building, a converted three bedroom cliff-edged oceanview house, was renovated and distance education operations commenced in the Fall Semester 1990. The Center contains office space, a communication control room, and a teleconference/distance education classroom. The communication equipment room and the integrated teleconference room are fully sound proofed by insulated tiles. The grounds support multiple HF, VHF, UHF, and Microwave antenna systems.

As the Micronet coordinator, the University's Center for Telecommunications has been selected to house two PEACESAT GOES Earth Stations. The PEACESAT Network has been granted access to a "used" GOES III weather satellite by the U. S. Department of Commerce's National Telecommunications and Information Administration. This satellite is presently being relocated to a geosynchronous orbit at approximately 176 degrees west longitude. The earth stations for the University and the other members of Micronet will be installed in the first quarter of 1991. The GOES L-band earth stations will provide one channel of "marginally commercial telephone quality" simplex push-to-talk voice or a duplex data channel that will be used for educational and medical purposes within Micronesia.

Presently the University's Telecommunication Center provides voice and data telelinks via High Frequency (single side band), Very High and Ultra High Frequency, Microwave at 1.2 GigaHz, and the soon to be installed GOES earth stations' three meter dishes. An online bulletin board system, a 24 hour fax, and phone-patch voice lines are maintained at the Center. Radio frequency integrated services that are available include multiple packet data systems, experimental slow scan (simplex picture phone), and medical and educational phone interconnects.

Services available on a daily basis include medical and educational conferencing and classes, and remote emergency telelinks for typhoon relief work, marine air-sea rescue efforts and support for local island services such as water, power, or other local

Micronesian emergencies when no commercial links are available. The University's Telecom Center has on site solar photovoltaic arrays, battery banks and inverters for unlimited and consistent power. The Center's main Macintosh/hard drive and printer are totally solar powered and isolated from island power to insure consistent voltage. To facilitate on site daily news and weather reports, the Center maintains incoming CNN television, broadcast radio news, and Amtor and Sitor with the high frequency coupled terminal node controller weather downlinks.

5.0 TWO EXPERIMENTAL DISTANCE EDUCATION MODELS

The first model developed by the University of Guam was based upon the use of commercially produced videotape series to replace classroom lectures. To date, two series have been tested in Micronesia: Alistair Cooke's America, Kosrae, 1985; and The Ascent of Man, Kosrae and Pohnpei, 1989. In each case the videotapes were available on site for participant use; participants were provided with the transcripts of the series and supplemental print materials; the participants and the instructor met weekly via single side band radio for discussion, oral reports, and supplemental lectures; and the instructor traveled to each site to begin the course. (7)

The second model was developed by the Pacific Staff Development Institute (PSDI) at the College of Agriculture and Life Sciences in 1989. PSDI was one of the projects funded under a consortium of Pacific land grant institutions known as Agriculture Development in the American Pacific (ADAP).

ADAP began operation in mid 1987 with the adoption of the two following primary goals which were to govern its and its projects' activities.

(1) To develop a comprehensive plan to accelerate and complement existing agricultural research and extension programs in the American Pacific.
(2) To facilitate and foster faculty-staff development among institutions in the region to strengthen the region's institutional ability to contribute to agricultural and economic development.

ADAP went on to develop the following three specific objectives. These objectives were designed to be regionally adaptable to meet the needs of the consortium institutions and their various clientels.

(1) To increase the flow of indigenous Pacific Islanders into formal post secondary degree programs within the food and agricultural sciences, beginning with existing faculty and staff who largely lack such certified educational training.
(2) To develop curricula for such degree programs which are culturally appropriate and relevant to Pacific island conditions throughout the entire region.
(3) To organize a cost effective instructional delivery system that will meet these needs and overcome the obstacles of: ocean distance; the high dollar cost of supporting faculty on site or students at the central campus; the cost of travel within the region; and the disincentive of lost income incurred by islanders who must relocate to obtain their education.

The Video Based Radio Interactive Model (VBRIM) was developed by PSDI in cooperation with TADEO and was designed to meet the above goals and objectives. In addition it included five developmental components to insure the efficiency and effectiveness of a course offered utilizing this model. These components were:

(1) a culturally sensitive adapted instructors'/facilitator's guide;
(2) a clear and concise Learner's Manual that contained a course syllabus that was developmentally and sequentially ordered;
(3) a culturally sensitive test bank, where appropriate;
(4) a delivery schedule that allowed the instructors the opportunity for a least one face-to-face meeting with the participants; and
(5) an evaluation of each of the courses modules.

The course offered via this model was entitled Extension Program Development in the Pacific Basin. It was offered for three undergraduate credits by both the University of Guam and the College of Micronesia. In addition the course was offered as a subunit of a graduate course by the University of Hawaii's Department of Urban and Regional Planning. Participants uninterested in earning degree credit were allowed to enroll in the course for Continuing Education Units from the University of Guam.

The course was offered to 89 participants on nine different islands. The islands served were Saipan, Yap, Belau, Pohnpei, Kosrae, Chuuk, Majuro, Oahu, and Pago Pago. The participants ran the gamute of agricultural professionals within the American Pacific. They included representatives from the region's Cooperative Extension Services, staff members of related governmental and non governmental agencies, and land grant faculty/Ph.D. candidates. The educational levels ran from Ph.D. candidates to participants working on their Associate of Arts Degrees.

The course consisted of the following four modules:

(1) The Philosophy and History of Extension Education;
(2) The Structure and Organization of Cooperative Extension;
(3) Program Needs Assessment and Planning; and
(4) Program Development and Evaluation.

The course was based on a nationally produced training series entitled, Working with Our Publics: Inservice Education for Cooperative Extension, produced by North Carolina State University in 1988. Video and audio tapes from this series were utilized dependent upon their relevance to Pacific conditions and concerns. These materials were supplemented by audio cassette tapes produced by the University of Guam dealing with specific Pacific Basin issues in each of the modules.

The audio and video materials were supplemented by the Learners Manual and additional print material. A library of assigned readings, videos and audio lecture tapes was provided to each site.

The two co-instructors traveled to each of the nine sites to conduct registration and provide 7.5 hours of lecture to begin Module 1. After this initial contact, the instructors and the participants held weekly teleconferences via single side band radio for the duration of the course, 15 weeks. The teleconferences averaged one and one half hours in duration and usually involved two sites simultaneously. During the teleconferences, the participants from the two sites involved discussed a series of questions, prepared by the instructors and distributed prior to the teleconference, with the instructors and each other. (9)

Three and four site sessions were experimented with during the course. Given the time limitations placed upon the discussions and the differing time zones involved, the two site formula was found to be the most effective.

Participants enrolled for undergraduate degree credit were expected to complete two written project assignments and four examinations during the course. The examinations were open-book and consisted of short answer essay questions. They were distributed and returned via the U.S. Mail.

Each learning site had a station operator and a course facilitator available for each interactive session. The facilitators moderated the course, assisted the students in answering the discussion questions on site, maintained the site library, and helped to facilitate participant/instructor communications.

Participants were encouraged to contact the instructors outside of the regularly scheduled teleconference sessions. These contacts took place via single side band radio and e-mail. E-mail facilities were provided by the ADAP Network which could be accessed at each institution's central land grant office. In addition the course provided for regular facilitator and instructor interaction for pedagogical and administrative purposes via single side band radio and e-mail. (10)

This model has several unique features. Three of these need to be singled out for special emphasis.

(1) The instructors were able to conduct classes from anywhere within the region utilizing the available telecommunications systems. As a result, the extensive travel demands placed upon the instructors by their other academic duties did not disrupt the course or the instructor's other work assignments. (11)
(2) A participant who missed an interactive session scheduled for his home island was able to "make up the session" by "attending" the session elsewhere. Either the participant could "attend" a session scheduled between two different sites during the week or, if he was traveling, he could sit in on his regularly scheduled or another session at a different site. This flexibility greatly facilitated the participants ability to keep up with and complete the course.
(3) The multi-site nature of the course forced the instructors, facilitators and participants to come to grips with the multicultural nature of the region. Each group had to develop a sensitivity to other cultural traditions and to begin the development of a set of multi-cultural techniques and methodologies that will facilitate contact between their agencies and/or institutions and will facilitate similar experiments in the future.

6.0 FUTURE TRENDS

Since the delivery of the courses described in this paper TADEO has continued to expand its distance education offerings. During the last year, it developed four new courses utilizing the VBRIM format. These courses are: Art Studio for Non Majors and Human Growth and Development, delivered Fall Semester 1990; and Introduction to Statistics and Fundamentals of English, to be delivered during 1991.

In addition a teaching internship program is being developed to allow teachers in remote schools to complete the student teaching requirements of their IDP's on their home islands. If this program proves to be successful, it will break new ground within the general area of distance education and greatly facilitate the ability of the University's IDP students to complete their degrees.

The Commonwealth of the Northern Mariana Islands has expressed an interest in using these courses and in jointly developing distance education courses with TADEO for use within its jurisdiction. Both the military and the Department of Education on Guam have expressed an interest in utilizing distance education delivery systems developed by TADEO to educate their employees and perhaps high school students as well.

TADEO intends to continue its present low tech distance education efforts to bring increased access to post secondary education to Micronesia. It also plans to go forward with the PEACESAT/GOES project to augment its present capabilities with more sophisticated electronic educational methodologies; such as, interactive data exchange, electronic study groups, bulletin boards and conferences, and an expanded use of e-mail.

While its primary thrust is in the area of pre-service and/or degree oriented courses, TADEO hopes to expand its distance education offerings into the areas of in-service training for teachers and other professionals within the region. Eventually it would like to join with Micronesia in an interactive and mutually supportive educational network which will support local educational activities at all levels.

7.0 FOOTNOTES

(1) University of Guam, *University of Guam Undergraduate Catalog: 1989-90* (Mangilao: University of Guam, 1989), p.p. 9-10; and *The University of Guam* (Mangilao: University of Guam, 1989), p.p. 3-6.

(2) *The University of Guam*, p.p. 3-8.

(3) UOG Board of Regents, "Inina, Fina'Na'Gue Yan Setbisio: The Mission of the University of Guam" (Mangilao: University of Guam, 1980), p. 1; B. Best, G. J. Boughton, B. Karolle, V. Martinez, and B. Camacho-Dungca, "Developing and Delivering Cost Effective Distance Education in Micronesia: The University of Guam's Experience in Bridging the Low and High Tech Gap," in *Proceedings: PTC 90* (Honolulu: PTC, 1990) edited by D. J. Wedemeyer and M. D. Lofstrom, p.p. 559-560; and B. Best, G. J. Boughton, B. Karolle, V. Martinez, and B. Camacho-Dungca, "The University of Guam's Experience in Delivering Distance Education in Micronesia," *Educational and Training Technology International*, V. 27, N. 3 (August, 1990), p.p. 258-259.

(4) Best et al, "Developing and Delivering Cost Effective Distance Education," p. 561.

(5) For further discussions of the IDP program see Best et al, "Developing and Delivering Cost Effective Distance Education," p.p. 561-562; and Best et al, "The University of Guam's Experience," p. 259.

(6) Best et al, "Developing and Delivering Cost Effective Distance Education," p.p. 559-561; and Best et al, "The University of Guam's Experience," p. 259.

(7) For a more complete discussion of this model see Best et al, "The University of Guam's Experience," p.p. 259-260; G. J. Boughton, "Distance Education in the Western Pacific," *Pacific Telecommunications* (May, 1989), p.p. 21-23; and G. J. Boughton, "An Experimental Distance Education Model," in *Distance Education: Development and Access* edited by M. Croft, I. Mugridge, J. S. Daniel, and A. Hershfield (Caracas: International Council for Distance Education, 1990), p.p. 49-50.

(8) The consortium consists of land grant programs at the following post secondary institutions: The Community College of Micronesia; the Northern Marianas College; The American Samoa Community College; the University of Guam; and the University of Hawaii.

(9) American Samoa was reached via single side band radio from Guam to Hawaii and then via PEACESAT's ATS-3 satellite from Hawaii to American Samoa.

(10) For an earlier account of this project see R. L. Workman, T. M. Iyechad, B. Camacho-Dungca, B. Best, "Telecommunications and Distance Education: Among the Pacific Island Land Grant Schools," a paper presented at the University of Guam's Research Conference, April 5, 1990.

(11) The authors would particularly like to thank PEACESAT-Honolulu for making its satellite and single side band facilities available to the instructors in this course while they were in Hawaii. PEACESAT's help in facilitating this experiment greatly enhanced its overall success.

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TWENTY YEARS OF DISTANT EDUCATION DELIVERY VIA SATELLITE IN ALASKA: LESSONS FOR DEVELOPING COUNTRIES

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1. ABSTRACT

This paper examines the distant education experiments done in Alaska in the 1970s and what was learned from them. It then looks at the planning, operations and demise of the Learn/Alaska network from 1980 to 1987. After a brief summary of the present state of distant education in Alaska, it closes with some conclusions that may be of value to other thinly populated areas with diverse educational needs.

2. INTRODUCTION

Delivery of health and education service via satellite is now entering its third decade in Alaska. The first decade was a period of experimentation, testing and evaluation. A great deal was learned, much of which was transferred to other states and countries. The second decade opened with the planning and development of the Learn/Alaska distant education system, regarded by many as the most comprehensive effort attempted in distant education for its time. This paper's primary focus will be on the second decade and the lessons that can be learned from its successes and failures in distant education.

3. EARLY EXPERIMENTS

The Alaska experiments on the Applied Technology Satellites (ATS-1 and ATS-6) have been reported on many times. The State of Alaska's first experiment in delivery of television via satellite has also been well reported. Here, we will very briefly review these experiments and the basis they laid for Learn/Alaska and other distant education programs.

The ATS-1 experiment in educational broadcasting in Alaska began in 1971 and originally incorporated 26 communities. It was limited to audio and data transmission due to the early failure of its video capabilities. This proved to be beneficial in a way since educators were forced to learn how much could be accomplish through audio. The experiment also proved the utility of 3 and 4 meter earth stations at high latitudes. ATS-1 was still being used occassionally in Alaska circa 1986.[1]

The ATS-6 experiment was conducted in 1985 and focussed on video programming to 16 communities. The experiment proved that video could be delivered through small earth stations at high latitudes from a satellite in geostationary orbit. It introduced rural teachers to satellite based television.[2]

The ATS-6 experiment raised expectations in rural Alaska enough to cause the Alaska Legislature to appropriate funds for a rural television demonstration in 1976. This demonstration continued through 1980 as a mix of educational services during the day and network television in the evening. After the establishment of the Learn/Alaska educational channel in 1980, the state funded channel was used totally for network and public television and continues so to this day. local distribution is via low power transmitters in each community.[3]

4. LEARN ALASKA'S RISE AND FALL

The genesis of the Learn/Alaska network was in a legislative direction to the Alaska Department of Education to investigate the feasibility of a statewide educational television channel. The following assumptions were used in planning for the network based upon the nine years of experimentation that had just taken place. Planning was done from July 1979 through January 1980 by a joint effort of the Department of Education and the University of Alaska.

The key assumptions governing network design and operation were:

> Audio teleconferencing would be the backbone of the system. Use of the network would be funded in the Learn/Alaska budget. This was to facilitate interaction between

students and teachers, between teachers and for instructing teachers and administrators on Learn/Alaska network utilization.

Instructional video should be available statewide. Courses would be selected annually by user working groups.

Television courses specific to Alaskan needs would be developed expeditously. These included fisheries, Alaska Native affairs, Alaska history and polar sciences.

Computer networking would be reserved to a later date. In 1979 Alaska teachers were just beginning a rapid expansion of the use of computer assisted instruction. Computers would be used for electronic mail initially and networked as teachers expressed a need for the service.

Learn/Alaska would provide instructional development expertise in distant education to teachers desiring to develop courses.

The existing educational systems in Alaska; the University of Alaska with some 30 units and the 53 school districts would be the institutions used for course delivery. The two private universities and other private schools would be urged to participate in the Learn/Alaska network.

In reaching these assumptions, the Learn/Alaska planners had the benefit of studying the Open University system in the United Kingdom since 1971. They had also studied the developing distant education efforts in the United States in the 1970s. The problems of incorporating traditionalist teachers and administrators in new systems were well recognized and concerted efforts made to remove their fears. Much was learned from the Open University experience in giving educators rather than program producers the lead in course development particularly in the television courses. Instructional development was viewed as the bridge between the two groups.

These assumptions were incorporated in the system recommended to the Alaska Legislature in January 1980. As a result the legislature funded an audio teleconferencing system that would be available to every school and university unit in the state. It also funded the lease of a satellite transponder for delivery of educational television to 100 sites. Another 100 sites were funded for television reception two years later. Funding was provided for a central staff to operate the audio conferencing network, deliver television programming, develop television and audio courses and to generally facilitate delivery of distant education services statewide.

Capital costs for the complete system came to $28 million and the annual operating budget at its peak was just under $5 million. This was less than one percent of the amount spent on education in Alaska, which is currently around $900 million.

By 1983 the system was fully developed in its audio conferencing and television delivery capabilities. Many television courses had been produced for primary and secondary schools dealing with Alaskan subjects. Over 200 audio course were being offered. The satellite television channel was providing an extensive menu of choices daily for teachers to utilize live or to record. Urban schools received television through their cable systems. A large cadre of teachers had been trained on distant delivery utilization.

The distant delivery system in Alaska was ready for its next step by 1984. This involved testing of integrated courses utilizing television, computers and audio, designed by the Alaska Department of Education for remote schools. Computer network planning was proceeding at every level. Expansion of television delivery to the urban fringe and to households not served by cable had been planned.

At this time, just as Learn/Alaska had matured as a delivery system, those rural legislators that had most strongly supported the network's establishment began to withdraw their support. The reasons for this were not clear at the time. The stated reasons were usually linked a legislators dislike of a particular program. The response of the leadership of the Department of Education and the University of Alaska to this was a general and subtle withdrawal of support. This was manifested by the failure to counteract the legislative opposition with a strong rebuttal. For the years of 1985 and 1986, the system's budget came under increasing attack in the legislature and was only saved by strong support from its users.

The response of the University of Alaska leadership was to give the Learn/Alaska system a reduced priority in internal budgeting, thus sending the message to the legislature that future efforts to reduce the system would not be strongly opposed. Since the operational units were incorporated in the university budget this affected delivery to the entire system. At the same time the Department of Education reduced its requests for course development funds for primary and seconday schools.

Finally, on June 30, 1987, the University of Alaska and the Department of Education announced to stunned school districts and university units that the statewide television service was cancelled effective immediately. This was done with no indication in public hearings that such a course was planned. Everyone had planned their next academic year on the basis of television availability; thus, the announcement caused great consternation and confusion. At the same time the audio conferencing budget was cut in half. No funds were available for television production. Learn/Alaska was in effect shutdown except for a greatly reduced audio conferencing capability and some television distribution in the urban areas over the cable and the public television stations.

At the time the system was dismantled, the Learn/Alaska system had been hosting a constant stream of visitors from all around the world for four years; educators coming to see the world's most comprehensive distant education network. As Australia's Roy Lundin stated, "For eight years, 1980-1987, Learn Alaska was the model educational network for and the envy of educational systems around the world. Thousands of visitors went to observe LA's operations and staff of LA were employed around the world, including Queensland, as consultants. As of June 1987, the whole system was disbanded as State funding of almost $5 million per year ceased. The public explanation is that the drop in the price of oil has put the state in severe economic constraints."[4]

Other than the price of oil, no reason was given by the legislature or by the state's educational leadership for the wrecking of the system. While Alaska's construction boom was severely impacted by the drop in oil prices in 1986, the state was still awash in public income and still had great discretion on what programs to fund and which to cut. Nothing had changed about the needs of education in Alaska. The educational system still needed to serve 265 communities spread over 1,530,700 sq. km. with a total population of 520,000. Only nine of these communities has a population over 5,000. The state is required by the courts to provide local education through high school in every community over 25 in population.

Few places on earth have greater justification for developing a sophisticated distant education system. No place, except for Kuwait and the Arab Emirates has greater per capita public income to do the job.

To this day, three years later, no public explanation has been made by the state as to why it turned its back on distant education. One hypothetical reason advanced is that the system was too successful in rapidly upgrading rural knowledge on what was going on in Alaskan government and that rural legislators were having a hard time handling the increased political sophistication of their constituents. Another explanation was that faced with decreasing budgets in 1986 due to the drop in oil prices, educational leaders simply placed distant education in a low priority category because it was a new system. Both of these explanations are supported by the precipitous and secret manner in which funding was removed from the system.

5. PRESENT STATUS OF DISTANT EDUCATION

After the demise of Learn/Alaska the University of Alaska entered upon a hard fought reorganization led by a new president. The reorganization eliminated the community college system in the state which had existed since Alaska was a territory and replaced it with three university units within which the former community colleges are incorporated. The remains of distant education had to function within this chaotic major structural change for the two years it took to reorganize. Since the audio conference system had been lodged within the university this affected all distant education in the state.

After the reorganization a slow rebirth of distant education has begun within the university system. Audio conferencing courses are increasing again. No television courses are being developed and no rural distribution system is actively being pursued. Some computer networking is in progress but it is still largely an ancillary service offering electronic mail and access to library services.

An interesting recent development was the announcement by the Alaska Department of Education that 40 rural schools would be taking part in a "classroom without walls" experiment that will enable students to take foreign languages and advanced math and science courses that are not offered in small school districts with limited resources. This demonstration is being funded by a U.S. Department of Education grant. The courses are provided by the State of Washington Educational Service District 101. These courses are similar to what was offered by Learn/Alaska up until three years ago. In its major aspects, the experiment is a repeat of ATS-1 and ATS-6 experiments of the 1971-1976 period except the demonstration utilizes microcomputers and facsimile which was not available then.

6. CONCLUSIONS

The burning question is why did Learn/Alaska fail?

First and foremost was the failure of the University of Alaska or the Department of Education to accompany the establishment of Learn/Alaska with an ongoing independent evaluation to provide input to the planning process. An evaluation was part of the original planning and it was funded for the first two years for evaluation with the University of Alaska. The evaluator was hired but was never authorized to go out into the system and report on what was going on in educational distant delivery. Rather his services were used to evaluate the endless organizational maneuvering of the University. Thus when Learn/Alaska was challenged in the legislature with unstructured anecdotal information, university pundits could only reply with their own unstructured anecdotes.

The Department of Education had some informal evaluation underway at times, but these efforts were never formalized and presented to the legislature. In its last two years, the staff of Learn/Alaska conducted some in house evaluation which indicated that the system was working. This information was disregarded by the legislature because by that time there was general distrust of information furnished by the University of Alaska.

The University Board of Regents and the local school boards were almost total nullities in the process. If any of them took a strong interest in distant education, it did not show up in the political process when support was needed. Rather they seemed to accept the establishment of the Learn/Alaska network as something nice to have but not a real part of education like space needs, utilities and other more comfortable areas of the education budget.

The system needed its own citizens review board to provide policy and program guidance from outside the regular education system. Such an oversight board, combined with a strong evaluation process, would have made possible the highlighting of problems that needed to be aired and, most important, could have made known the system's successes to the public and their elected and appointed representatives.

Consideration was given when Learn/Alaska was planned to creating an independent system, such as British Columbia's Knowledge Network or the Open University. It was decided not to do this because distant education was so vitally needed throughout the Alaska educational system except for its three largest communities. It was not forseen that such an early and strong opposition would come from the legislature to a system that was created by legislative initiative. Neither was it apparent that the University of Alaska would prove to be such an unprotective host to the system. Finally, there was strong and continued opposition from the public television and the public radio stations, who throughout the short history of Learn/Alaska regarded it as a competitive threat to their viability, even though it was made clear at the beginning that the target audience for Learn/Alaska was traditional education, not public education.

In retrospect it would have been wiser to first restrict the system to the rural areas and to develop a special system to serve them, rather than burying the effort in the politics of the major university units and the three large school districts in Alaska. The planners of Learn/Alaska should have studied more carefully how the Open University avoided confrontation with the traditional education system in the United Kingdom. Much was learned from the Open University but this lesson was missed.

The pace of technological inovation adopted by Learn/Alaska seems, looking back, to have been about right. The problem of trying to move teachers too rapidly in technological change was recognized. This was the main reason why Learn/Alaska utilized audio telconferencing heavily as the medium of distant education which teachers could use most easily and felt least threatened by.

At the time Learn/Alaska was established, the teachers of Alaska had been exposed to nine years of distant education experimentation and a strong cadre of knowledgeable educators existed at the primary and secondary levels. Experience in the University of Alaska was spottier with the School of Nursing having the most experience. Monies were available for teacher training and instructional development assistance was a part of system development. Training materials were made available from the time of network start up.

The future of distant education in Alaska is still somewhat murky. There are many dedicated teachers in the school districts and the universities who are doing their best to advance the state of the art. Computer networking and facsimile open new avenues for insertion of greater print and graphics components in lesson plans.

The main problem is the institutional framework within which the delivery systems for distant education operate and how delivery systems are funded. In a state like Alaska where educational quality is dependent upon effective distant education, it will be tragic if this problem continues to be resolved by happenstance and incremental decision making rather than comprehensively evaluating the state's distant education needs once again and providing the means to meet those needs.

7. LESSONS FOR DEVELOPING COUNTRIES

Audio teleconferencing offers the most cost effective means of iniating distant education in almost all situations. As a next stage of development, computers and facsimile can expand the range of quality and types of courses available without incurring great developmental expense.

The production costs of television courses will continue to be an inhibiting factor for courses that are culturally relevant. The great breakthrough will be in the distribution costs of video programs which will make teleconferencing affordable for many that cannot afford it now. Alaska with all its wealth could not afford video teleconferencing for most situations and acquired little experience with it.

Educational systems should focus on supporting para-professionals working in rural areas as a major clientele in addition to serving the needs of traditional students. Continual training of professionals is another important area to serve.

Centralized technical support agencies should be viewed with care. They can view their support mission as an end in itself that is more important than the missions they are funded to support.

The institutionalization of distant education within each countries educational system will never be easy. Alaska has not worked it out yet. Starting with a good needs assessment in the classroom and working towards the top is safer than working from the top down. This can avoid the trap of funding high cost items and having nothing left for the tools necessary in the classroom to implement distant education.

NOTES

(1) For a complete history of the ATS-1 experiments in educational broadcasting in Alaska from 1971 to 1974 see: Parker, Walter B., Village Satellite I, (1972), Village Satellite II, (1973). and Village Satellite III, (1974), all by the Alaska Department of Education, Juneau, Alaska 99811

(2) For a description of the ATS-6 experiment see: National Institute of Education, Implications of the Alaska Education Satellite Communications Demonstration for Telecommunications & Education Policymakers, January 1976 Washington, D.C.

(3) For a description of this demonstration see: Alaska Office of the Governor, Office of Telecommunications, Satellite Television Demonstration Project, 1978, Juneau, Alaska

(4) Lundin, Roy, Communication and Information Technologies in Business and Education, Brisbane College of Advanced Education, Kelvin Grove, Queensland, Australia, p. 25

It Is Benefit to Us to Use Television and Satellite in the Field of Education

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Abstract

This paper deals with the long distance education using telecommunications in China. It includes a brief introduction of the development of the audio visual education, the slow growth and problems China confronted in the early uses of audio visual education and an introduction of the development of TV Universities and Satellite TV education to make a positive impact on the educational development in all areas of education in China.

China, a country with five thousand years of history, has a vast territory of about ten million (10,000,000) square meters, as well as a great variety both in topography-plain in the southeast, mountain area in the southwest, plateau in the northwest, and in climate.

Composed of fifty odd nationalities, the current population of China is about one billion and one hundred million, ninety three per cent of which are of Han nationality. The distribution of the population is not even, ninety per cent of the population lives in forty per cent of the territory. In east China's Yang Tze delta, the population density is about more than three hundred and fifty people per sqrare kilometer, which is similar to the density of the Netherlands.

Within the vast territory with the many nationalities we have variety of different languages for different nationality or area, for example, most people can speak Beijing mandarin but Beijing people can not understand ShangHai or GuangZhou dialect.

In the forty years after nineteen forty nine, in which year the People's Republic of China was founded, the development of education in China has been improved. Now we have about one million primary schools, a hundred thousand middle schools, one thousand institutions of higher education and many different colleges for professional training. The number of enrolled students of different levels and in various types of institutions is about two hundred and ten million, or twenty per cent of the total population.

Audio visual education program was in its embryonic form before nineteen forty nine. Electric gramphone and audio tape recorders were used in foreign language teaching. Later, in the early fifty's, audio tape teaching was added as a supplement. In other courses,as in physics, chemistry, biology of middle schools and some courses in architectural schools, slide projectors were used in teaching. Some well equipped schools showed their students some science and educational films as a means of teaching. This could be called the early stage of the audio visual eduation program in China.

With the open policy and reformation, we saw a big leap in the development of audio visual educational programs during the year of nineteen seventy seven to nineteen seventy eight. This was the results of the turning point of teachers and professional to meet the needs of better education.Foreign countries with progressive experiences and information sent assistance. We imported some advanced educational equipment which was used in the field of education, such as video system and micro film.

Then the Audio Visual Educational Bureau was established under the Ministry of Education (now called the State Education Commission), and was responsible for the development of audio visual education program. Shortly after, the National Audio Visual Education Center and the Central Radio and Television University (CRTVU for short, below). I was appointed to the position of the technical adviser of the above two groups. This was the beginning of my research in audio visual education and the study of this field. At the same time, similar establishment also appeared at the provincial and local levels.

The development of equipment and in teaching materials in this field was very swift. In a short span of several years, a lot of video cameras, video players, film projectors, slide projectors, over head projectors, audio tape cassette recorders, micro film equipment, copy duplicators and dark room apparatus were used in schools of various levels and types. (for example the language labouratory was quite popular in foreign language teaching).

With the development of an audio visual and long distance education programs many buildings for audio visual education were built, such as T.V. schools, audio visual centers, program producing centers, T.V. studios, audio recording studios, audio visual classrooms, auditoria and other auxiliary buildings.

Problems that developed and the differences in the development of audio visual education with some foreign countries are as follows;

1. Difference of names; The term "A.-V. Education" is internationally acknowledged, because the program always involves sound and picture. However, in China, we usually call it "The Education System with Electrical Equipment" which means the employment of electrical equipment in the education process. The name also brought some debate for not all audio visual education involve electricity, such as, magnetic green chalk board, visual aids, models, and so on. But when we write in English we use the term "Audio Visual Education" which is used by the author of this paper.
2. China has paid more attention to hardware than software. Since the development of audio visual education started at a low baseline, much of the construction was buildings and equipment, which focusing energy on the hardware, we failed to pay enough attention to the software, research of the relevent theories, compiling of teaching materials, etc. The importance of the software is now understood. After all, when the hardware development comes to a saturation point, the development of software naturally follows.
3. Audio visual educational buildings; Buildings for audio visual education from central level to provincial and local level are used to produce teaching materials, like T.V. studio, recording studio, slides studio etc. Some of them are used to teach students. Some are well equipped audio visual classrooms. The capacity of these classrooms varies from dozens to thousands of students. As a result of the financial condition and the lack of qualified personels, more attention was given to the construction of the "shell" of the buildings than to the construction of better interior conditions of the buildings, (especially in the audio visual classrooms), the result is the unsatisfactory condition of ventilation, lighting, acoustics quality, noise control, vibration etc. These conditions will be improved gradually.
4. Audio visual libraries; I visited some audio visual libraries abroad, where audio visual materials are stored and these are open to the public. Readers have easy access to these materials for information. Schools have libraries open to the students and teachers. However, in China, this kind of libraries are non-existent. Collection of audio visual materials in the National Audio Visual Center and some audio visual educational individual centers are not open to the public.
5. Video teaching; In China, more attention is given to television education programs (video tape). The production of a video program requires complex equipment, techniques and large investments. People tend to neglect the regular use of audio visual education media, like slide projectors, over head projectors etc. This is also reflected in the assignment of teaching hours. The hours using video tape are often more than those using other media of audio visual education. In some cases,

the whole class hour (forty to fifty minutes) is used for video tapes. The video program could be replaced by slides or films, and be more effective. Audio visual education and television education are synonymous.

6. Applications of audio visual equipment outside the schools: There is a need to increase the use of audio visual media expanding the use in explanation of exhibitions, introduction of enterprise to visitors, tourists guide, answers to public information and inquiry etc. All could employ audio visual equipment which are common abroad, but in China, the application of audio visual equipment in school is far more developed than in other aspects.
7. Work-saving for teachers: The education level is still low in China in some regions and there is a shortage of qualified teachers, therefore the selected use of the audio visual education programs could help remedy this situation. I have noticed that the employment of audio visual education abroad is not always saving work for teachers, but increase teachers' work instead, for it is time-consuming to prepare the audio visual materials, In China, however, some people do think audio visual education programs are work-saving as a result of repetitive use of materials once made.
8. Audio visual network: Although the audio visual education network has been formed, the cooperation and the work sharing within the network are not well developed. In most cases, the audio visual systems in China are self-contained, resulting in low efficiency and waste. A survey of more than fifty universities in a city shows that each has one or two T.V. studios. Efficiency could be improved with the introduction of central management of the universities T.V. studios.

The telecommunications in China have obtained a rapid development, especially in recent ten years of the reform and open policies. We realized that telecommunications are an important component part of social productivity, the fundamental project in the national economy and the necessary condition for social development. This basic point of view has been accepted by more and more people. Especially, with the development of planned commodity economy and export-type economy along coastal areas, the importance of telecommunications is being more and more deeply sensed. They are getting very significant for the construction, production, education, scientific research and even daily life in China. Therefore, telecommunications are in rapid demand.

As for the long distance education in China, it has an epoch-making significance that the CRTVU was formally established in February 1979 because at that time we were lacking in adult education, vocational education, qualified teachers and sufficient trained people, especially in far away and remote regions, so the foundation of CRTVU was the inevitable trend and created a new age of education system in China.

Many improvements in CRTVU have been made in the past decade. The glory for these improvements go to the millions of teachers and students that used the long distance education and made it work. Now the programs developed in China are honored all over the world.

In nineteen seventy nine the illiteracies and semi-illiteracies, under twelve years old, were two hundred and thirty million people, that is one quarter of the population. The higher education was falling behind, only eleven point six persons per ten thousand was enrolled in higher education. Adult, vocational and continuous education were not meeting the needs of the population. Educational investment were not enough.

The above mentioned educational situation could hardly meet the needs of new China's modern economical costruction. We faced a very severe problem of improving our educational system.

During this time the amount of formal education for staff and workers was low. Only about thirty per cent of them were in higher education. About half of them were in below junior middle schooling, and about ten per cent illiteracies.

And the formal schooling status of the leading managing carders was low. Talented professional management, financial and economic leaders and those in politics and law were unqualified. A more severe situation existed in far away regions, villages and minor nationality areas.

The remedy came with the rapid development of China telecommunications, especially the TV stations, relay stations and some other facilities construction. The importance of telecommunications to meet the needs of education is very significant. With the development of the long distance education and the growth of telecommunications, the significant policy for the CRTVU establishment was set up, while the traditional education was going smoothly. TV universities got wide range social benefit with rather lower investment.

CRTVU has opened many types of education. They are;

A. Schooling record education;
  a. middle level specialized education.
  b. universities and specialized colleges.
B. Non-schooling record education;
  a. single course education.
  b. vocational technology education.
  c. post personnel training.
  d. speciality training.
  e. continuous education including both university and post university education.

The main component is the universities and specialized college education. As for the specialities, they have developed steadily as shown in the appendix.

The long distance education of TV university is based on the modern electronic technology. During last decade, The National government gave trippled investments to TV university, which was used to equip TV stations, satellite and transmitting facilities. There was local investments in addition to Central. So TV universities have owned learning centers, audio visual media producing centers, experimental centers, libraries and resourse centers. There has been more than twenty thousand basic level training classes, that composed of the long distance   system.

During the last decade, the CRTVU has been established, forty two radio and television universities are located in the provinces, municipalities and autonomous regions, five hundred and forty branch schools in prefectures and cities, more than eleven hundred county stations, educational TV stations in nine provinces or municipalities, twenty nine program production centers, eighty five learning practice centers offer more than four hundred courses for one hundred and thirty specialities. More than a million students graduated from TV universities and over two million received certificates for various single courses in continuous education and job training. Some of these people have made important contributions in the field of industry, agriculture and education. TV universities have proved an effective way to develop higher education and became important components of the higher educational systems.

TV universities edited and printed more than seven hundred teaching materials, the publications totaled one hundred and fifty million volumes. More than one hundred and fifty kinds of video tapes (ten thousand teaching hours), one hundred kinds of audio tapes (six thousand teaching hours). And also trained a teacher's team with long distance education experience, a team of administration and techniques.

TV Universities enlarged the scale of higher education and is the main component of it. It is estimated that from nineteen seventy nine to nineteen eighty eight, the TV universities had one million and six hundred thousand enrolled students, and one million of them graduated from T.V. universities which was the forty per cent of traditional universities.

The TV universities gave more attention to the development of Chinese literature, financial and economics, politics and law specialities in addition to focusing on science and engineering. So they played the important role to adjust the disorder proportion of the speciality structure within the education distribution. The capacity of those specialities is far wider than the traditional universities.

In the TV universities, the teaching quality is good, the teachers are qualified, the teaching materials are advanced, the investment for a TV university student is about one third of that at a normal university. Faced with the above mentioned achievements, we still have many problems which should be improved;

1. The quality of education and the social effect are not steady and well balanced all over the

whole country.

2. The teaching and viewing rate of the broadcasting and video tapes are lower in some regions.
3. The students spent resonable time viewing audio visual tapes from TV, satellite and micro wave on the earth, but the additional writing materials and documents are not sufficient.
4. The design and improvement of teaching and textbooks are needed. Some people know the TV program as a simple movement of the chalkboard from the ordinary classroom to a new TV studio.
5. We have not yet summarized the experiences of long distance education and open learning as are very suitable to self study in developed countries.
6. Teaching is much more than thinking, the independent working ability therefore is interfered.

Although we have got great achievements, the TV universities for the ninety's should strive for the following improvements;

1. Should be clear and definite the aim or goals of the TV universities.
2. TV universities will reform the educational plans to meet the needs of social economic developments.
3. TV universities will continuously edit teaching materials and audio visual media with long distance educational features.
4. To train two teams; teachers with experience in science and long distance education; and technicians with experience in administration and techniques.
5. To strengthen the research for long distance education.
6. To better the leadership of TV universities.

The most significant is the transmission by satellite of educational TV. on October first nineteen eighy six. It broke the traditional, closed, short distance education, and gave every one in our country access to the programs.

Our vast territory, large area of deserts, long coast line, numerous islands and the uneven distribution of population makes the TV coverage difficult. Before the satellite was in use, only thirty per cent of the total population was served with educational TV, despite the higher quality and the lower cost of this media.

It is a very important reformation step of educational system that the State Council decided to utilize the satellite for developing TV education. China's Education TV Stations, run by the State Education Commission, overcame many difficulties and continuously transmitted for hours. It formed our Satellite TV education center. In October nineteen eighty six we formally transmitted the first group programs(CETV-1), seventeen hours transmitting per day. On October six nineteen eighty seven, the State Education Commission established China education TV satellite and in November nineteen eighty eight, transmitted the second group programs(CETV-2)., more than thirty hours transmitting per day for the two groups. Courses content are under the control of CRTVU, China TV teachers institute, central agricultural radio and TV school, Continuous education, Comprehensive education and Educational information. By the end of nineteen eighty nine, the dose transmission up to thirty thousand hours.

The satellite programs can cover all of China, Southeast Asia and Austrilia. The young satellite TV education has developed its rapidly and brought evident benefits and wide interest from world wide countries.

Under the plan of State Education Commission, there will be four satellite TV education channels in nineteen ninety five-two thousand. The programs will include vocational education, middle and primary schools as well as kindergartens. The total transmitted hours will go up to seventy hours per day.

Since the transmission of satellite TV education channels a lot of earth stations receivers and instructed video playing net work has been accomplished. It is estimated that three hundred and sixty eight relay stations, one thousand and six hundred receiving stations and more than fifteen thousand playing centers were put into use which show the achievement of satellite TV education system. The satellite TV education system combined the superb talent with the outstanding result of reformation in the form of education, so it offers the best conditions of exchange, inspect learning and improvement for a wide range of teachers. The future of the use of the satellite TV education will reap high rewards.

Much remains to be improved. The programs are only received collectively. There is no dialogue between the teachers and the students before the TV screens. Educational materials for students and for teachers are not available.

In a word, it is true that the audio visual and telecommunication education in China is just getting off the ground, with many things to be done. It has achieved the following during the last decade;

1. China has a good hardware foundation. The investment has been big. Equipment (both home made and imported) have been abundant. Inventory for nineteen eighty seven listed two hundred and fifty thousand O.H.P. and Slide projectors, three hundred and twenty thousand tape recorders, sixty six thousand TV sets, eighty thousand video recorders, four thousand video cameras, one thousand and four hundred audio visual classrooms and three thousand language labs.
2. China has contingent of personnel working for audio visual educational programs. There are quite a lot of staff in TV Universities, in TV polytechnical schools, in audio visual centers and in various kinds of schools.
3. A series of audio visual educational materials have been compiled. They are for TV universities, for comprehensive satellite TV educational programs, for reference materials, for middle schools and for primary schools.
4. Radio and TV universities and polytechnical schools have fostered a lot of qualified personnels.
5. The operation of the educational TV channels and establishment of TV normal universities are promoting the quantity and quality of teachers in middle schools and primary schools, and now nine-years compulsory education is universal.
6. Audio visual education programs have been popular in schools of all kinds, and have become a significant means of promoting teaching quality. Audio visual centers have been established at local levels. eighty nine per cent of all the prefectures and cities, and sixty eight per cent of the country established departments which are responsible for audio visual educational programs. Audio visual educational programs are undertaken in most of universities and polytechnical schools and in some of the middle schools and primary schools, all over China.
7. Much experience has been accumulated in audio visual education. In recent years extensive exchanges with companies abroad have benefitted audio visual education.

The developmental direction of audio visual education in China is to promote teaching quality and foster qualified personnel of various kinds with the aid of modern technology. To this end, the focus of our energy should be on the following aspects of work;

1. Reform the current audio visual education system and define current goals.
2. Adjust the structure of Radio and TV education to meet the needs of vocational education.
3. Broaden Radio and TV education to meet the needs of all areas of learning.
4. Reform the management of audio visual educational programs.
5. Augment the compiling of audio visual materials.
6. Establish criteria for personnel in audio visual education.
7. Promote the efficient use of the equipment.
8. Better the telecommunication condition for transmitting the educational programs.
9. Formulate a policy statement that all persons in audio visual educational programs can follow.

Of course, TV education and satellite education are the fruit of the development of telecommunications. If there were no audio visual aid, broadcasting, TV stations, satellites, we could hardly imagine the education by long distance right now.

I would like to close my paper with its title again it is benefit to us to use television and satellite in the field of education.

Appendix : the speciality TV universities have developed

Types	Specialities	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Agricul-ture	Agricultural teachers										*	
	Agricultural planting										*	
Economy management	Finance and tax					*			*		*	*
	Finance and banking					*			*		*	*
	Statistics					*			*			*
	Accounting and audit					*			*	*	*	*
	Economic management					*			*	*	*	*
Social science	Politics and history											*
	Library and files							*			*	
	News							*				
	Law							*			*	*
	Special courses for carders						*	*				
	Chinese literature				*			*			*	*
Science and engineer-ing	Computer engineering											*
	Management engineering						*					
	Civil engineering						*		*		*	*
	Chemical and light engineering						*		*			*
	Normal school courses				*		*					
	Electricity engineering	*	*		*		*		*	*		*
	Electronics engineering	*	*		*		*		*	*		*
	Mechanics engineering	*	*		*		*		*	*		*
Types	Specialities	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989

Evaluating the Benefits of A Computer Based Telecommunication Network: Telementoring and Teletraining for Educators in Rural Areas

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Telecommunication advances in computer based networking are fast becoming a vital information tool and resource in the field of education. The evaluation of the educational benefits of telecommunications includes the delivery of resources and training to educators in rural schools and the enhancement of communication between educators and students. The evaluation of the Winthrop College Telementoring-Teletraining-Telecommunication Project has national and international implications.

Telecommunication network innovations are having a tremendous impact on increasing and enhancing teacher training programs. Computer networks enable educators to link together all levels of the educational spectrum. The networks promote communication and the transmission of electronic research and data nationwide, as well as worldwide. Technological advances in the area of telecommunication have assisted educators in:

- delivering teacher training programs in rural areas,
- developing and adapting instructional materials and curriculums,
- sharing information and resources locally, regionally, nationally and internationally,
- delivering college courses to students residing in rural areas,
- linking schools, businesses and agencies together, and
- preparing students for the knowledge and skills required for the technological needs of the future.

According to Kendall and Anfin (1989) telecommunication advances in computer networking are demonstrating educational benefits such as reducing the cost of providing and delivering educational information and data to school districts in rural areas, increasing communication between educators, and serving as an instructional tool for enhancing teacher training programs.

At the Pacific Telecommunication Council's 12th Annual Conference in 1989, Drs. Kendall and Anfin from Winthrop College presented a paper regarding the development and problems of establishing a computer based telecommunication project for educators called, **Telecommunications-Telementoring-Teletraining.**

> In July, 1987, the South Carolina Commission on Higher Education awarded Winthrop College a grant to support a Center of Excellence in Early Childhood Education (COE). The grant was made possible by funds from the Education Improvement Act (EIA). One of the objectives of the Center was to establish a telecommunication network to provide inservice teacher training to educators in early childhood-special education, located in rural areas in South Carolina. A telecommunication network was recommended due to the need for trained teachers in early childhood-special education. (Note: The passage of Public Law 99-457 addresses the needs of educating handicapped and at-risk

children from birth to age five. In addition, the mandated legislation of Public Law 94-142 Education for all Handicapped Children Act requires all states to train teachers to meet the needs of educating and caring for exceptional children.)

Another reason for establishing a network was a need to expedite the delivery of information to teachers working in rural schools. Due to the fact that South Carolina is 70 percent rural, the delivery of inservice training to those teachers presented a major concern. The physical isolation of many rural educators makes it difficult

(a) to deliver training and research information on a frequent schedule,
(b) to problem solve with teachers regarding educational problems,
(c) to provide immediate feedback regarding questions, concerns and requested information, and
(d) to provide daily mentoring and support to the teachers as they work and care for handicapped children.

To address the problem of providing on-going teacher training to educators in rural areas, the COE established a computer based telecommuni-cation network called Telecom-munications-Telementoring and Teletraining Project (TTT). The primary goals of the project were to

- promote communication between early childhood and special education professionals in the state,

- provide teachers with access to educational data and other information pertinent to their field of study,

- assist in providing information and research regarding the integration of handicapped and high-risk preschoolers into early childhood and day care programs,

- instruct teachers in the operation of utilizing a computer modem to interact with an electronic bulletin board system,

- demonstrate the various methods in which teachers can share information and teaching practices with other educators in the state, and

- provide additional graduate level college training, known as teletraining, using the computer and modem as the means of receiving instruction and returning assignments.

Concepts of Telementoring and Teletraining

Telementoring is the process of utilizing a telecommunication network between an institution of higher education and public schools located in rural areas. The faculty provides support in terms of assisting the district administrators with problem solving related issues; in providing research information and training practices to the teachers; in keeping educators updated regarding educational opportunities, resources, services, legislation and conferences (Kendall & Anfin, 1989).

Teletraining is the process of training educators in their perspective fields using telecommunication technology (a computer, a modem and telecommunication software) to deliver instructions and research to educators in rural areas. This method provides additional training opportunities for personnel who are normally restricted, due to their location, in taking advantage of inservice and college courses. The college faculty is required to adapt the curriculum and assignments for transmission over the computer. One advantage to computer delivery of instruction is the individualized manner in which the instructors must communicate with the students.

Networking allows multiple communication and information sharing between numerous computers in a school, office, district, state, nation and the world by using phone lines, modems and telecommunication software programs.

In addition, the participants were introduced to the electronic Bulletin Board System. The electronic Bulletin Board System enables users to share and obtain information, access public domain programs, and pull resources from around the state and nation. (Kendall, & Anfin, 1989).

Evaluation of Telecommunication

The impacts and benefits of the COE's telementoring and teletraining project were evaluated by external consultants, Drs. Berry and Kijai. They focused the evaluation on the 1988-90 telementoring participants, drew on a variety of quantitative and qualitative indices, and sought to elucidate how the program participants used the information generated and disseminated by the COE.

The methods, findings, conclusions and recommendations are as follows:

METHODS

Using a variety of quantitative and qualitative indices, an evaluation system was designed to monitor the use of the network information by participants and how their attitudes, behaviors, and skills changed over the course of one academic year -- Fall of 1989 through the Spring of 1990. The procedures used to collect these data included interviewing key administrators, analyzing program documents, compiling utilization logs, surveying participants, and interviewing selected teachers and supervisors.

The Surveys of Participants

Almost 80 percent of the participants completed their telementoring sessions during school hours mainly because it was in their schools where they had access to computers. Those participants that did have computers in their homes tended to do their telementoring sessions after school hours. For most participants (70%), their sessions lasted less than 30 minutes. Table 1 displays the participants' assessments of their competency with computers and research both prior to and at the end of the telementoring program. It is quite clear from the table (using a correlated t-test as a statistical measure of significance) that participants' perceived competency in the use of computers and research information (and research journals) improved significantly by the end of the year. The participants assessed critical issues related to the implementation of the telementoring project both at the beginning, as well as the end of the year. It is quite apparent from the "after" means that the participants were much more able to accomplish their intended task at the end of the program year. Additionally, by the end of the year the participants seemingly had more access to their computers, were more able to demonstrate the operation of the PC, and were more able to send and receive electronic mail as well as telecommunicate with other colleagues (Note: These positive changes were not statistically significant, but worth highlighting.)

Table 1

Assessment of Telementoring Sessions

(N=450)

Statements	Rated Excellent (in percent)
a. Accessibility COE telementoring network	93.0
b. response time from COE staff	96.0
c. relevancy of information received	92.0
d. understandability of information received	94.1
e. user friendliness of telementoring equipment	93.7

Also, the survey results revealed that at the beginning of the program year the participants felt that they had sufficient information about the operation of personal computers and the Bulletin Board System (BBS) and they felt that they could send and receive electronic mail, as well as telecommunicate with other colleagues. The survey data revealed that the participants felt that administrators demonstrated support for their telementoring efforts. However, what might be considered surprising is the decrease in the level of support for the program among principals and central office personnel. Again, the decrease was not statistically significant, but worth noting.

The Utilization Logs

The teachers were instructed to complete a utilization log each time they logged on the telementoring bulletin board. There were approximately 450 telementoring sessions logged from October to May 1990. These telementoring sessions were conducted from schools, as well as from some of the participants' homes.

The most common reason for using the telementoring program was to communicate with the staff of the COE at Winthrop College. Another common reason was to receive research news.

Of greatest import: The most frequently cited type of research news sought was the integration of handicapped children into early childhood education programs (26.7%). Research on working with parents was sought almost 16 percent of the time while simulation and intervention teaching strategies were sought almost 15 percent of the time.

Table 2 displays how the participants assessed the quality of their telementoring sessions. Over 90 percent of the telementoring sessions were rated excellent by the participants. For example, in 93 percent of the sessions the participants were able to easily access the Center of Excellence telementoring computer network. In nearly 96 percent of their telementoring sessions, the participants rated the response time of the COE staff to their inquiry as excellent. In over 94 percent of their sessions the participants considered the research they received as being understandable. (In less than one percent of the telementoring sessions, the participants considered the information they received as irrelevant.) In general, the participants considered the telementoring process as being "user friendly."

Table 2

Participants Ratings* of their Competency (N=15)

Variables	After	Prior	Difference
Competency in...			
a. using computers	3.57 (0.53)	1.75 (0.89)	1.71** (0.29)
b. understanding research journals	3.43 (0.53)	2.63 (0.74)	0.86** (0.26)
c. using research information	3.57 (0.53)	2.50 (0.93)	1.14** (0.34)

* Based on 4=excellent; 3=good; 2=fair; 1=poor.

** $p < 0.05$

(Number in parentheses is standard deviation).

FINDINGS

The school districts became involved in the telementoring project primarily because of the "good relationship" district officials had with Winthrop College. The positive relationship between Winthrop and these districts seemed to mitigate one of the primary concerns that some district administrators had about the program -- the inexperience that teachers (and supervisors) had with computers. As one teacher noted:

> Most teachers would not get involved because they were fearful of computers -- computerphobia.
>
> Another asserted:
>
> I was terrified of computers -- much like other teachers -- I couldn't even type and did not know how to turn the computer on. But, I like challenges.

The positive relationship between Winthrop and these districts also seemed to mitigate other concerns as well -- the difficulty of implementing a telementoring program and the possibility that the College would "dictate to teachers" what they should teach. These concerns were alleviated -- in part -- by the management style of the project director. As one supervisor noted:

> We were all learning...[The project director] has been real patient... We had such a diverse group of people -- those who have never turned a computer on and those who knew DOS upside down. The people at Winthrop made it enjoyable and nonthreatening.

Also, the COE exerted considerable effort in serving the needs of their constituent school districts -- from answering questions promptly to troubleshooting telephone hook-up problems. COE staff were constantly in the school -- especially in the early implementation phase. Some districts "jumped at the opportunity" to get involved with the telementoring project because of the program's possibilities with students and their interest in innovative practices outside their districts. As one teacher noted:

> Our school has a lot of slow learners but the children are fascinated by technology.

Another supervisor asserted:

> We could find out what other districts were doing to solve problems, for example reading problems. Plus, we would get some equipment and experience with computers.

Finally, several teachers decided to take the course because they "needed the three hours of certification" credit. For these teachers, the possibility for recertification was the "bait," but it did not remain the raison d'etre for completing the course. As will be revealed, the telementoring program fulfilled many of the participants' professional development needs.

CONCLUSIONS AND RECOMMENDATIONS

In sum, the initial implementation of the telementoring project appears to have a salubrious effect on practitioners -- especially in its relationship to (1) learning new information, (2) utilizing scarce resources efficiently, (3) professional development for teachers, and (4) empowering students to learn for themselves. Interestingly, some of the districts involved "jumped at the opportunity" to become a part of the computer network because of their perceptions of the program's possibilities with students and their interest in innovative practices outside their districts.

The COE appeared to market their product (i.e., the telementoring program) very well and then proceeded to serve the participants as if they were million dollar clients. In essence, during the crucial initial implementation period of the project, COE staff were on-site -- solving both technical problems (making sure the equipment worked) and cultural problems (making sure teachers and administrators became comfortable with the innovation).

Several of the participants decided to take the course because of recertification and graduate credit. But as previously mentioned, while the "hours" may have been the "bait" to lure participants to the course, it was definitely not the raison d'etre for completing the course. Their professional development needs were met with the telementoring program.

Participants primarily used the telementoring program to communicate with the staff of the COE, as well as to receive research news. The most frequently cited type of research news sought was the integration of handicapped children into early childhood education program.

Participants rated the program very highly and considered the network extremely accessible. The COE staff was rated as particularly supportive. Just as important, teachers -- who have been known not to use research -- found the research they received as being understandable and useful. Also, the participants' self-assessments of their competency in the use of computers and research improved significantly by the end of the year. Additionally, by the end of the year the participants felt like they had accomplished more, had better access to their computers, were more able to demonstrate the operation of the PC, and were more able to send and receive electronic mail as well as telecommunicate with other colleagues.

In addition, participants felt that the telementoring enabled them to work more effectively with other teachers and began the process of collaboration and sharing -- a critical variable highlighted in the current school reform movement. The telementoring process began to allow teachers the opportunity to view themselves differently -- consultant, researcher, computer communicator, and facilitator of students learning how to learn. All of these roles are considered to be important for teachers to undertake so that as practitioners they can take part in the dialogue about and ultimately direct the transformation of public schooling.

Based on the data collected and analyzed, the following recommendations were presented:

1. Winthrop College should continue to support the further development of the telementoring project and consider ways to integrate the concept into the formal and traditional means of pre- and in-service education. The telementoring concept should be integrated with the mission of the newly-established COE at Winthrop College. In addition, the telementoring project should be considered as a first step in enhancing the possibility of

developing Professional Development Schools (a` la The Holmes Group) with their emphasis on collaborative inquiry between professors and practitioners.

2. Winthrop College should ensure that the telementoring program is properly staffed so that practitioners will have access to the expertise needed to solve both the technical and cultural problems associated with the implementation of this "high-tech" innovation in the public schools.

3. Winthrop College should continue to offer graduate credit for the practitioners who complete the course and its requirements. Graduate credit appears to be an important incentive to "lure" practitioners into this innovative, but somewhat path-breaking program.

4. School district and site administrators need to work to establish more support for telementoring to occur. Teachers need more time to telementor and more computers will be needed as more teachers find the need to be a part of what could be a contagious network of learners.

Conclusion

Unfortunately, less than 10% of all educational institutions are using effective telecommunications (Weinstein & Roschwalb,1990). John Sculley, chairman and chief executive officer of Apple Computer, addressed this issue by stating:

> How is it that we have recognized the economic value of Industrial Age tools. . . and yet we don't seem to recognize the economic value of Information Age tools in education? . . If we're going to be successful in this global economy we've got to change the way people think, communicate, learn, and work. We can do this with many of the technologies that we have today.

Mecklenburger (1990), stated that education that relies on electronic learning is the future. But making this future a reality, sensibly and for the good of the nation, is the restructuring task of the 1990s that educators have yet to consider. Projects such as the COE Telementoring and Teletraining will help administrators and educators to realize the wealth of resources that telecommunications can bring to the teachers and students.

References

Barnett, B. & Kijai, J. (1990). Assessing the Impact of the Center of Excellence Telementoring and Teletraining Project. Educational Research Consultants. Columbia, South Carolina.

Kendall, R. & Anfin, C. (1989, January). telecommunications-telementoring-teletraining: enhancing and providing teacher training programs in early childhood-special education to educators in rural school districts. Pacific Telecommunication Communication Processings. 654-663.

Mecklenburger, James. (1990). Educational technology is not enough. Phi Delta Kappan. 105-108.

Sculley, J. (1989, October). The education summit: global markets, global education. Speech delivered at Fortune Magazine Seminar, Washington, D. C., 29, October 1989.

Watson, B. (1990, October). The wired classroom: American education goes on-line. Phi Delta Kappan. 109-112.

Weinstein, S. and Roschwalb, S. (1990). Is there a role for educators in telecommunications policy? Phi Delta Kappan, 115-117.

THE STRENGTHS AND WEAKNESSES OF MICROCOMPUTER AIDED AUDIOGRAPHICS TELETEACHING FOR DISTANCE LEARNING

by

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Paper Prepared for 13th Annual Pacific
Telecommunications Conference

Honolulu, Hawaii
January 13-16, 1991

Abstract

This paper provides a description of microcomputer linked audiographics teleteaching as a low cost medium for distance learning that promotes high levels of student teacher interaction and local control of the distance education teacher and the curriculum. Strengths and weaknesses of this approach to distance education delivery for students in rural and geographically isolated schools are presented and briefly discussed.

Technologies used for distance learning

Several different types of audio and video technologies are available which are being used by many rural and geographically isolated schools as alternatives to face-to-face education making it possible to provide live instruction over long distances. These technologies permit the delivery of televised courses via lower power television, Instructional Television Fixed Services (ITFS), cable, fiber optics, satellite, or slow scan TV. Courses can be delivered in either a one-way or two-way format depending on the hardware equipment available at both the origination site and the receive (distant) site locations. Courses are also being delivered via microcomputers networked via regular telephone lines, fiber optics, or microwave telephone signals.

Of the popular distance education technologies currently in use, televised satellite transmissions are receiving the most attention [9]. In Hawaii, microwave TV as utilized by the Hawaii interactive Television System, has received the greatest amount of funding by the state legislature and is the major medium for distance education delivery in the island chain [1].

Both satellite and microwave TV technologies require sizeable investments in equipment outlay and in maintenance and operation. While it is true that hundreds of students could receive instruction simultaneously either via satellite TV or microwave TV, local school control of the curriculum and direct supervision of the "electronic" or "master" teacher is severely minimized. Furthermore, large class size significantly reduces opportunities for teacher/student interaction [3,4].

The purpose of this paper is to describe a low-cost distance learning approach that helps safeguard local school control of both the electronic teacher and the curriculum while at the same time limits class size to help ensure high levels of teacher - to student and student-to-student interaction.

What is microcomputer aided audiographics teleteaching?

Barker and Patrick [3] described microcomputer aided audiographic teleteaching as a PC-based system which incorporates computer-generated graphics that function much like an electronic chalkboard. The system requires specially designed telecommunications software that is available for Apple and MS-DOS microcomputers. The telecommunications software allows the user to create computer graphics and multi-sized text called "slides" which can then be transmitted in real time from one machine to another. Once online with other compatible PCs, the system operates on a "common screen" basis--that is, whatever graphic or textual material (slide) is executed from the host screen/monitor (location) automatically shows up on all other screens (distant locations) simultaneously. Visual exchange of slides is in a still-frame mode. Motion is not possible.

Computers at host and receive sites are linked over regular telephone lines for two-way visual exchange of text and/or graphics. Two-way audio interaction between the teacher and students at distant sites is via speaker telephones, also over regular telephone lines. Addition and use of a facsimile machine permits hard copy exchange of instructional handouts and/or student written work.

The model for audiographic teleteaching is usually a collaborative arrangement between two to three schools or institutions to form a cooperative. The "network" co-ops human, financial, and equipment resources. Each cooperative member has an equal voice in determining curriculum content, scheduling, selection of the teleteacher, etc. Cooperatives can be formed and dissolved on an as-needed basis from a large consortium of telecommunication partners, but the focus remains one of local control and small class size. Inasmuch as cooperatives are typically limited to networks of two to three schools linked together, small class size is ensured. In present on-going audiographic teleteaching cooperative networks, the average class size ranges between 4-15 students with class size seldom exceeding 30 students overall [2,6,10]. This guarantee of small class size ensures greater opportunity for both teacher/student interaction and student/to/student interaction. Students are able to interact not only with their teacher, but also with other students at different sites. Along with teacher/student interaction, the opportunity for student/to/student interpersonal communication between all sites--albeit electronic--is a major advantage of this approach to distance education in contrast to most other telecommunications delivery systems. The prospect of student/to/student exchanges not only increases the likelihood of socialization between students but also fosters the potential for peer tutoring and small group study.

Strengths of audiographics teleteaching

Among the major strengths of this approach to telecommunicated distance education are:

1. *Local schools maintain control of the master teacher, programming, and scheduling.* Because the network is typically small and locally controlled changes in selection of a teacher, programming offerings, scheduling, etc. can easily be changed.

2. *Small class size is guaranteed.* This type of technology does not permit linkage with more than three sites simultaneously. Some microwave TV distance learning systems have 60+ sites while some satellite TV distance learning systems have over 1000 students in multiple sites being taught simultaneously [9]. Meaningful teacher/student exchanges with such large classes, compounded by the fact that the instruction is delivered via distance technologies, makes high levels of interaction between teacher and students highly unlikely.

3. *The system supports student/to/student interaction between sites in addition to teacher/student interaction.* The speaker telephones act much like an "open" microphone. Once the classes are connected, students in one location can speak at-will to their teacher or to other students in another location. Telephone talk-back or interaction by students does not need to be re initiated each time a student wishes to ask a question or to make a comment.

4. *Low cost in terms of hardware, software, and maintenance.* Start up costs for an individual school to participate fully in an audiographics cooperative network need not exceed $5000 to $6000 [3,4]. Major equipment items per site include an MS-DOS microcomputer (640 K Ram with a 20-40 megabyte hard disk); either a CGA, EGA, or RGB monitor; a 1200 or 2400 baud Hayes compatible modem, a graphics tablet, a speaker telephone, a printer, a facsimile machine, a scanner, and access to regular telephone lines. There is usually no annual subscription fee for courses as is typical for most satellite and/or microwave TV distance learning courses. One time software costs vary between current vendors, ranging between $1300 - $4000 per site [3]. The on-going operation costs are usually limited to the monthly telephone charges and toll charges for linkages between sites where long distance toll charges are incurred.

5. *Relatively simple to learn and to operate.* Learning to use and operate an audiographics teleteaching system does not require extensive technical knowledge or training on the part of the user. Most teachers who know how to use a microcomputer for word processing can quickly learn the skills and technique necessary to successfully operate an audiographics system.

6. *Any participating site can serve in either a "receive" or a "transmit" mode.* Hence, instruction can emit from any participating site. Therefore, each school on the network can offer courses electronically as well as receive instruction.

7. *The computer generated visuals can be activated and accessed by the teacher as well as any student at any remote site.* Instruction on the system or control of the system can be alternately switched from one site to another in a matter of 1-2 seconds. This allows for high levels of interaction between teacher and students.

8. *Instructional content is focused more on the organization of the material than on the personality of the teacher.* Students at distant sites do not see the teacher. A common visual reference is shared on the computer screen and students and teachers freely interact orally via the speaker telephone. Hence, the charisma or personality of the teacher seems to be less of a factor in learning than is the organization and structure of the content.

9. *Operates over regular telephone lines.* Therefore, linkages between distant sites can be made almost anywhere in the world. Just as easily as linkages can be formed between sites they can also be dissolved thereby allowing for flexibility in the networks.

Weaknesses of audiographics teleteaching

As is true of all other distance learning technologies, this approach to instructional delivery is no educational panacea. Among its disadvantages are the following:

1. *Motion is not possible.* Display of visuals on the computer screen is in a still picture or freeze-frame mode.

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2. *The instructor cannot see the student, nor can students see the instructor or other students at distant sites.* The teacher and students at each site all share a common computer generated graphic on their respective computer screen, but they do not see each other.

3. *Loss of transmission connection.* Extraneous noise or interference on the telephone lines can cause voice transmission on the speaker telephones to occasionally "break up" resulting in a loss of transmission or disconnection.

4. *The video graphics/image displays between computer monitors is limited to the size of the computer screen unless additional hardware is added.* Additional hardware may include a large TV monitor (eg. 25 inch) or use of an LCD type projector joined with an overhead projector to enlarge the computer image on a big screen.

5. *Lesson planning (creating of computer visuals) can be considerably time consuming for the teacher.* In addition, floppy disks which are used to store the slides created for each lesson must be distributed to all remote sites and loaded into networked computers prior to transmission or a lesson. It is possible to "down load" the slides to each computer but this must be planned for and still can be somewhat time consuming.

6. *Transmission costs for telephone toll charges can become excessive.* Most current audiographic networks operate on two separate telephone lines. One for computer connection and one for speaker phone connection. Unless distance sites have access to WATTS lines or other lower cost carriers, telephone toll costs can become burdensome.

7. *Audiographics is not a "turn-key" operation.* Management of a computer teleteaching network requires a commitment by local school administrators in terms of human resource time to train teachers to instruct over the system and to prepare slides and lessons for delivery over the system. Many satellite and microwave TV systems are administered in a distant location which is away from the local school thereby requiring limited or no local administrative monitoring.

Evaluation of audiographics teleteaching as a distance education delivery system

Several studies have established audiographics as an effective distance education medium [2,3,4,5].

Current audiographic telelearning networks in North America exist in Canada, Pennsylvania, Utah, Alaska, Texas, Louisiana, New York, North Dakota, South Dakota, Alabama, Hawaii, South Carolina, and other states [7].

To those who already work in this medium or who may be interested in using microcomputer aided audiographic teleteaching as a distance learning technology in the future, the following suggestions are offered [3].

1. Audiographic slides must be well designed and properly sequenced. Instructors should "story board" or carefully plan each visual for a lesson before actually creating the slide/visual on the computer. Principles of effective visual communication (balance, harmony, contrast, lettering, etc.) should be incorporated when creating slides.

2. Questions to learners participating at distant sites should be preplanned and range from low order (recall or knowledge) to higher order (syntheses, analysis, problem solving, etc.) on Blooms taxonomy or cognitive questions. The teleteacher needs to ask a lot of questions in order to "force" interaction with the learners. After posing a question, the teacher should allow sufficient "wait" time for students to process information before they answer.

3. Efforts should be made to involve all learners at each site in class activities. Calling students at each site by name to participate in class discussions will personalize lessons as well as convey to students that they are each responsible to participate as active learners. Directed questions to a specific student(s) can be an effective approach in gaining more student participation. The instructor might also maintain a log -- by student name -- of who is participating and who is not. This might be used as a record to help remind the teacher to call upon non-contributing members in the class or to more equitably distribute teacher/student interactions.

4. The teleteacher must articulate clearly and distinctly. Verbal instructions from the teacher must be precise and explicit. Too much teacher talk, especially if the teacher is rambling, can cause confusion. Also, a voice that portrays enthusiasm, variety in tone, and diversity in pitch and pace will do much to maintain student interest.

Remarks

This paper has attempted to describe microcomputer based audiographics teleteaching as a low cost and viable approach to distance learning that can serve as a means to provide live, interactive instruction to students in rural and otherwise geographically isolated schools. We have also attempted to present some of the inherent strengths and weaknesses evident in this approach to distance learning.

While this approach has merit, as do many other distance learning methods and technologies, it is the contention of the authors that no distance learning approach can or will replace well qualified and well prepared instructors who teach in a real life face-to-face setting with students. Today's technologies simply do not compensate for the spontaneity and extemporaneous interchange that exists when motivated and "turned on" students interact freely with the teacher in the same classroom. Technologies are bringing students in isolated settings together who might otherwise not be allowed educational opportunities, and this is exciting. Yet, we do not believe they will ever be an equal substitute or replacement for face-to-face instruction when teacher and students are physically in the same room.

References

1. Bannon, James (1990, October 27). Personal Communication.

2. Barker, B.O. (1989). Distance learning case studies. Report prepared for the U.S. Office of Technology Assessment, Washington D.C. Available through the U.S. Department of Commerce, National Technical Information Service (PB#90125295), Springfield, Virginia 22161.

3. Barker, B.O. and Patrick, K.R. (1989). "Microcomputer based teleteaching: A description and case study." Computers in the Schools, 6(3/4), 155-164.

4. Bradshaw, D.H. (1989). Audiographics distance learning: A guidebook for educators. Far West Educational Laboratory, San Francisco, California.

5. Ellertson, K. (1987). Report on distance learning: A national effectiveness study. Unpublished report prepared under contract with the Pennsylvania Teleteaching Project. Mansfield University, Mansfield, Pennyslvania.

6. Gorton, L. (1989). Summer telelearning for academic renewal: A team taught, audiographic distance learning program for at-risk-eighth graders. Unpublished report prepared for the Delaware--Chenango Board of Educational Cooperatives, Norwich, New York.

7. Neights, G. (1990, November 30). Personal communication.

8. Satish, V., Land, J., Thomas, T. Trott, J. and McCameron, F. (1989, October). Potential of audiographic computerized telelearning for distance extension education. Paper presented at American Evaluation Association Meeting, San Francisco, California. ERIC ED 317 199.

9. U.S. Congress, Office of Technology Assessment, (1989). Linking for learning: A new course for education. OTA-SET-430. Washington D.C.: U.S. Government Printing Office.

10. Wydra, D.J. (1987, December). "The Pennsylvania audiographic teleteaching project." Presentation delivered at the 8th Annual Conference for Administrators of Community Schools in Texas. Lubbock, Texas.

"Emerging Applications in Wireless Communications"

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INTRODUCTION

In the past year, there have been a plethora of announcements regarding new wireless initiatives. To the casual observer, programs such as WIN (Wireless In-building Network), CT-2 (Cordless Telephone-2), DECT (Digital European Cordless Telephone), and PCN (Personal Communications Network) represent an "alphabet's soup" of technology acronyms. Because these programs are wireless, there is a tendency to view these programs as direct competitors. However, a deeper look at the applications would indicate that some of these systems may in fact be complementary solutions that offer targeted price/performance levels to different classes of customer.

The wireless systems finding success will be those that most precisely meet the application requirements of a chosen customer segment. This paper will illustrate which technologies will best serve the varied applications for wireless communications in the 1990s and beyond.

CURRENT SITUATION

The current state of affairs in wireless communications can be summed up by the word "confusion". For example, the question is often asked, "Which technology is going to win, CT-2 or PCN?" The answer to this question depends upon an understanding of addressed applications.

Personal Communications is one example of a wireless communications concept that is not well understood. There are a number of perspectives on what personal communications is. For example, the cellular industry sees it as "Cellular is PCN", and the main goal is inter-operability among different local cellular operator systems. New entrants see PCN as a competitor to cellular, and are trying to enter the market with the attribute of low cost. Telephone companies on the other hand see PCN as an adjunct to their in-place wired networks, and are striving towards integration of wire and wireless capabilities. And interexchange carriers see PCN as a potential bypass for the local loop.

A simple definition of personal communications is any device that allows the person to communicate away from a fixed point. Radio therefore is the key enabler to personal communications, giving users the ability to move away from a fixed point.

What are the current examples of personal communications? There are already many today, including paging, private mobile radio, cordless phones, and cellular; all give varying degrees of untethered freedom and personal communications capability. The extent that personal communications today are so popular, is proven by the fact that there are well over 100 million wireless communications devices in the world today. Some other examples of personal communications and how it is evolving are illustrated by looking at cellular and the proportion of mobiles to portables. Back in 1987, sales of portable phones only accounted for 10% of the market. But now with advancements in technology and shrinking of size and weight of phones, as well as consumers realizing the benefits of personal and portable communications, we expect that by the end of 1990, the market will be about 50% portable. In fact, such U.S. markets as Las Vegas, experience current run rate shipments of about 90%. The Far East, Hong Kong in particular, experiences high portable demand similar to Las Vegas.

By the year 2000, we expect that there will be over 500 million wireless devices in service It is important to note that with the future of wireless communications, there will not be just one single device; there will be more that one wireless communications device per person, depending on how and where they use it. There will be many opportunities for different kinds of solutions.

It is important to realize that personal communications isn't solely public systems-oriented. There is a range of private solutions that are also or will be geared towards personal communications. With private solutions there is the capability to tailor the applications to specific requirements. So there will be numerous private personal communications services.

ENABLING TECHNOLOGIES AND SERVED MARKETS

One of the enabling technologies that will allow for personal communications is microcell architectures. Microcell architectures are optimized for more defined and focused coverage areas, be it for a department, a floor, an entire building, a city block or city blocks. A number of microcell alternatives will be available based on three very important dimensions: What are the coverage area requirements? What are the voice and data densities as well as usage intensities; that is, how many people are being served in that given area, and what are their requirements for voice, data, or both. And ultimately, what is the frequency availability? So a number of these technology alternatives are driven by regulatory issues, frequency availability as well as what the markets served would actually desire.

To explain some of the details of various applications, let's look at two dimensions, one called "Enabling Technologies" and the other called "Basic Markets Served." Today there are such enabling technologies as analog cordless telephones, digital cordless telephones, paging, cellular, land mobile radio and satellite. Basic markets consist of residential, on-the-move roaming, and business office segments.

Looking at each of the three overall markets in greater depth, in the residential market there will be either basic phones for in the home, or enhanced, neighborhood kinds of wireless communications. In the on-the-move roaming market, there are either personal or vehicular communications. And the implementations of the above can be through either island coverage, linked islands, or continuous coverage systems. In the business office market, there has been much attention paid to cordless PBX's, but again, a deeper look at the applications indicates that there are a diversity of communications types in the office, ranging from small key systems to cordless PBX's, Centrex, radio LANs, terminal-to-host data communications, and what can be termed wireless premise distribution systems for an entire building.

Evolving out of these enabling technologies will be such products as CT-2, wristwatch pagers, digital cellular, SMRs, and low earth orbit satellites, such as Motorola's Iridium program.

Looking at cellular, there are a number of ways that it could evolve in the future to serve some of these basic markets. Initially, digital cellular will be primarily focused on vehicular communications with continuous coverage. Microcells or PCN, because of its low-power nature, may serve the same applications in vehicular and continuous coverage that digital cellular does, but also perhaps will expand into residential environments, as well as perhaps, in-building. And if you look at paging, for example, one could see certain aspects of paging blending into cellular perhaps, or into such things as telepoint types of systems, as well as function-specific paging devices for office and continuous coverage.

Where is this all going to go in the future? There is a cloud of uncertainty, in the 1995 to 2000 timeframe. Some of these acronyms for future systems have appeared in the press (RACE, UMTS, etc.) What will ultimately transpire depends on the degree to which manufacturers drive these enabling technologies and operators implement them, and the degree to which the markets are going to accept the evolution of these different products and their performance capabilities.

APPLICATION CONSIDERATIONS

Public Communications

It is instructive, in talking about future public personal communications systems, to look at both network considerations and end-customer considerations. From a network perspective, sufficient network capacity must be made available, because capacity has a direct reflection on the service level offered to the customer. At the same time, from the end customer perspective, consideration must be given to the subscriber device; that it is body-friendly and something that the customer would want to carry with him and use. So next generation technology developments require a delicate balancing act: between the subscriber equipment considerations for small and simple with economic manufacturability, so that a low cost unit can be offered to the subscriber; but also from the network standpoint, being able to economically deploy high capacity systems. The success of next generation personal communications will then be optimized only if the operator is able to offer a lower service pricing to attract the mass market and have the lower cost infrastructure in place to offer those lower prices at a profit.

Private Communications

Let's now look at private personal communications. Some talk about cordless PBX's as "the" solution for the office, but in looking at the types of use, one realizes that the business desktop is a very busy place; workers are using their phones all the time, they are also typing on their computers. Serving such a communications-intensive environment requires a significant implementation of capacity to serve the applications in today's modern office, be it for voice communications, Local Area Networks, or messaging.

So we believe that in the in-building segment of personal communications, there will be a wide range of need. In particular, we see the need for wireless for departmental reconfigurations. We estimate that in the industry, there are about 40% moves, adds, and changes of computer and communications equipment in a typical office area. So we see the office, with its heavy data usage, as a key market for wireless because of its cost and frequency of reconfiguring. We found that, as with personal computers in the office environment, departmental needs require departmental solutions, so one potential implementation of wireless is at a departmental level to provide Local Area Network communications.

In contrast to data applications, our market research found that in the near term, there was not going to be that much interest in personal, on-premise portability However, this will vary depending upon whether or not the application is for a small business or a big business. We see small businesses adopting personal portables inside a building much more readily than in large businesses, simply because the density of phones in small businesses is not as high as in large offices. So there is a need to have communications while away from the desk in smaller businesses.

SYSTEMS EVOLUTION

What does the future hold? One way to depict the evolution of certain systems is on three dimensions: one being coverage area, from in-building, ranging all the way to out-of-building and world-wide; capacity of the system, ranging from low to high capacity; and application, be it voice, messaging, or data.

Analog cellular today is mostly a metropolitan area service, with relatively low capacity, serving mostly voice communications. We see certain technologies evolving, such as telepoint applications for location-specific voice communications. In the office environment, we see the need for high capacity systems to serve data intensive office markets, and high capacity will be achieved, because of high frequency re-use enabled by low-power microcells. Finally, we see certain PCN systems and advanced Digital Cellular systems offering a greater degree of capacity, with the capability to add applications beyond voice, in coverage regions that are expanding out of the metro area, to both regional and to more location-specific levels, such as inside buildings.

CHALLENGES FOR THE FUTURE

As far as the challenges for portable and network development, it is a simple fact that people use their phones more if they can carry it with them. And people will use their phones if they are able to get service wherever they want it, which requires a significant commitment to deployment of radio coverage. We also see significant wire and wireless integration, with a greater degree of network intelligence required. The requirements in wireless communications are much steeper than in traditional landline communications, simply because the system has to find the person wherever he's at in an area, and has to stay with him as he moves, so it is key to have significant network intelligence. This is especially important in the case of the personal telephone number - where is the subscriber going to be found? Is he going to be found out of the residential central office, or the business central office, home or roaming cellular switch, paging service or voice mail? How will this person be located through these numerous networks?

The challenge of combined capabilities, or the single device that can accomplish everything, is a goal that has been often mentioned. When one looks at the dimensions of talk time, power, and call duration, and locating the subscriber, one finds that the performance requirements are much different for in-building coverage versus wide-area coverage. Locating the subscriber is much more difficult in a wide area system than it is in an in-building system. The talk time in an in-building system is longer simply because transmit power is lower, and therefore, battery life is greatly extended. But also the call duration in-building is much greater than it is in a wide area application. So there are significant differences in those two domains.

Some of the issues as far as going forward: From a personal subscriber's standpoint, remaining in control will be an issue. How can a subscriber manage his calls so that he can be the one in charge of when and where he wants to be accessed. From the operator standpoint, implementing enough capacity to provide consistent quality of service, with sufficient network intelligence to provide seamless communications between various wire and wireless domains.

As far as evolution of networks in the 90's, we see wireless as the critical factor to future personal communications; it is going to cause us to think about new ways of deploying equipment, services and spectrum. We believe that there will be high recognition of wireless benefits among customers, so it calls for greater spectrum resources and technology advancements in order to serve. Ultimately, developing and providing personal communications for the masses is a collective challenge for manufacturers, governments, and network providers.

THE DIGITAL DECADE: ADVANCED MOBILE COMMUNICATIONS IN THE ASIA/PACIFIC REGION

Michael Chow
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The dynamics of the Asia/Pacific Region will offer both difficult challenges and interesting opportunities in the coming decade. It is an area rich in potential and one where we are likely to see some of the most dramatic developments in telecommunications in the years ahead. One of the most interesting areas will be in advanced mobile communications. While we've already witnessed widespread consumer acceptance of today's analog paging and cellular technologies, it is the movement toward digital communications technologies that hold the greatest potential for future growth. In the U.S., Europe and the Pacific Rim, we're seeing more interest on the part of both traditional and non-traditional mobile communications customers, service providers and manufacturers in the benefits of digital technology.

Why is the mobile communications industry going digital? What does this trend portend for the emerging nations of the Asia/Pacific region? And how will this endless stream of bits and bytes affect the worldwide voice and data communications industry? I'd like to touch on some of these questions and more as we discuss a growing trend that will undoubtedly turn the 1990s into what I call "The Digital Decade".

The Worldwide Growth of Mobile Communications

First, let's take a quick look back at the recent history of mobile communications. Since cellular service was introduced in the early 1980s, the number of cellular subscribers worldwide has grown to approximately 10 million. By the end of 1991, that number is expected to reach 14 million and by year-end 1992, 18 million.

There are now nearly 100 cellular networks in operation in more than 70 countries around the globe. Once found only in a few well-to-do nations, cellular service is now in use by nations as diverse as Argentina and Australia, Thailand and Taiwan, the Bahamas and Bahrain. Just last year, new cellular networks were established in Italy, Austria, Algeria, Hungary, Mexico, Kenya, Guatemala, Colombia, and Malta.

This worldwide growth is also reflected in the Asia/Pacific Region, perhaps one of the most fertile markets for mobile communications in the world. Japan, Hong Kong, Singapore, Indonesia, Australia, Taiwan, Malaysia, Korea, New Zealand, the Philippines, Sri Lanka, China--all of these countries have at least one cellular network in operation and several have more than one system, serving thousands of customers. And with the economic growth and need for service that is forecast for the region, experts believe the Asia/Pacific region will be one of the leading markets for mobile communications in the 1990s.

The Limits to Analog Systems

But there are limits to this growth--and, perhaps, the biggest constraint is technological. Frequency allocation and consumer demand are major concerns. In several U.S. and European markets, demand for service is so great that it has overwhelmed the existing networks. In fact, World Cellular Report notes that "By 1992/1993, many of the existing cellular networks will have reached saturation."

By that time, the number of cellular subscribers in Europe alone is expected to have grown to over 7 million. In several major cities, the demand for mobile voice and data service is clearly greater than the original analog networks are capable of satisfying. Users today want clearer reception, faster access to dial tone, and more reliable, widespread coverage--and that calls for a new generation of more advanced cellular technology.

Many existing analog systems have reached capacity, and the local communications authorities are adding analog capacity to help satisfy demand until more advanced networks are in place.

For instance, in Singapore, the Telecom's Network already has 25,000 subscribers on a system designed for 45,000. They are adding about 3,000 customers a month, and planning a new TACS Network for second quarter of 1991. Hopefully, it will handle demand until a digital system is ready, in 1992-1993, at the earliest.

Malaysia's two cellular networks are jammed during peak hours, sparking debate about adding a third one.

Korea, with 25 percent of its population in the coverage area, is expected to have 71,000 subscribers at year-end 1990, 122,000 by year-end 1991. The hope is that completion of an expansion by the end of 1991 will increase capacity to 200,000 and accommodate the increased demand.

In Thailand, a new NMT Network is being built to complement the existing systems. And in Indonesia, a 30,000 capacity AMPS System is under construction.

The Move to Digital Cellular

How will the world respond to this wave of consumer demand? By introducing in the coming year and gradually shifting to a new generation of higher capacity cellular networks known as digital cellular. In Europe, the Asia/Pacific Region, and several U.S. cities, the world's first digital cellular networks are now under construction. Later this year, the first cells of the Groupe Speciale Mobile or GSM Network will begin operations in parts of France and the U.K.

By the late 1990s, the GSM Network--which is also known as the Pan-European Network--may be serving as many as 15 million people in some 20 European nations. And by the end of the decade, World Cellular Report predicts that, as many as 45 million Europeans will be using analog and digital cellular, as well as the new low-power, low-cost personal networks known as PCNs.

Digital cellular technology offers several significant advantages over today's analog systems. One is the additional capacity: digital networks will initially be capable of handling three times as many customers. As new voice and data compression techniques are discovered, that number will likely double and perhaps double again. This is a far more efficient use of frequency spectrum than the first generation analog networks.

In addition to the greater call-handling capacity, digital technology provides improved sound quality and improved accuracy. This is particularly important as we move toward sending and receiving greater volumes of data via cellular-equipped laptop computers or other mobile terminals. As compression techniques are improved, mobile data transmission is expected to become an increasingly important market for sales people and executives, as well as public safety, shipping and other businesses worldwide.

Digital cellular networks also make it possible to provide a wave of enhanced user services, such as international and inter-system roaming, call waiting and call return. The PCNs now under construction in the U.K. and under consideration in Germany and elsewhere will likely use advanced digital techniques for voice compression and decompression, as well as for inter-office trunking. Finally, there is the issue of compatibility with land-based integrated digital services networks or ISDN.

While initial network development and equipment costs for digital cellular will be somewhat higher than analog systems, competition between equipment manufacturers and suppliers, as well as a worldwide move to digital cellular, is expected to moderate the costs of digital cellular by the mid-to-late 1990s. With the emergence of digital CT2/Telepoint and personal communications networks, we are likely to see a two-tiered cellular communications price structure emerge--digital cellular for high-volume business users and lower cost, lower power digital telepoint or PCNs for the mass consumer markets.

Implications for Asia/Pacific Region

What does all this mean for the countries of the Asia/Pacific Region? For one thing, they can benefit from the experience of others. Countries that haven't yet entered the cellular mobile communications marketplace will soon be able to "leapfrog" the first generation of cellular technology by focusing on digital cellular networks, CT2/Telepoint or PCNs, rather than traditional analog systems.

In addition, many countries with existing analog networks, notably Hong Kong, Singapore and Japan, may add digital networks or PCNs to handle substantial growth in consumer demand. Indeed, since the introduction of competition in Japan's cellular market two-and-a-half years ago, there has been significant subscriber growth. Nearly half-a-million units were in use by the end of 1989, an increase of over 100 percent from the previous year.

Another 250,000 to 300,000 units are expected to be put into operation by the end of the current year. Thus, Japan's first cellular provider, Nippon Telegraph and Telephone, is working to develop that nation's first digital cellular network by 1992.

I'm pleased to note that the first digital network in the region's southern hemisphere is being developed for New Zealand by my company, BellSouth. By mid-1992, shortly after the Pan-European Digital Network becomes operational, we will begin serving our first customers in New Zealand with a compatible GSM Digital Network. Incidentally, we will be competing with Telecom New Zealand, which currently serves more than 22,000 cellular subscribers from their analog network.

The Digital GSM Network in New Zealand is being designed in such a way as to facilitate a natural evolution to more advanced personal telecommunications services later in this decade. Specifically, we intend to blend the GSM technology with the land-based integrated services digital networks of the future. We hope the movement toward a hybrid GSM-ISDN network will facilitate faster, easier mobile data and fax transmissions.

Like New Zealand, the government of Australia is also considering opening up that country's cellular service to competition. Since beginning service in the mid-1980s, Telecom Australia has signed up over 140,000 subscribers. Whether new networks will be allowed in Australia and whether they will be analog, digital or PCN or telepoint derivatives remains to be seen, but there are clear indications that some change is coming. If a new network is established in Australia, we are hopeful that it will be compatible and will help lead to the creation of an Asia/Pacific GSM Digital Network.

Hand-held portables are extremely popular in Hong Kong, where three existing cellular networks serve over 100,000 people. With a population of just 4 million, Hong Kong has the region's highest cellular penetration rate, ranking just behind the U.K. as of year-end 1989. To help meet some of this overwhelming demand, the government and existing service providers have begun studying the possibility of developing digital cellular networks.

In addition, the government is considering proposals for a CT2/Telepoint Network. If approved by the government, the new network would probably be brought on-line sometime next year.

Taiwan has more than 22,000 subscribers, while there are more than 40,000 subscribers using the two networks in Thailand.

Non-Traditional Uses of Cellular

As you can see, there is significant consumer demand in the major business centers of the region. But there remain many areas throughout the Asia/Pacific Region that are not yet being served by cellular communications at all. However, these countries may be viable markets for cellular, particularly if their land-based telephone networks may be outdated or overburdened. For some of these countries, cellular--either today's analog or tomorrow's digital networks--may be a practical alternative to building an extensive and expensive land-based communications network.

While cellular networks are typically seen as a premium item, for many emerging countries around the world they can be a basic part of a communications infrastructure. Compared to a land-based telephone network, cellular systems are less expensive and easier to install. In nations where local telephone service is poor, people use their portable cellular telephones instead--at work, home or play. In Borneo, for instance, coin-operated cellular telephone booths have been installed in the place of traditional hardwired pay stations. In Indonesia and many other countries, portable cellular units are used to conduct business--day in and day out.

As the world's scientists and researchers develop new communications technologies, countries whose current telecom infrastructure is weak may decide to exploit low-cost cellular technologies instead of incurring the cost of full-blown hardwired networks. They could, in effect, chose to ignore existing analog wired and wireless technologies in favor of a more efficient form of mobile communications--PCNs, CT2/Telepoint or some other form of digital cellular.

The Transition from Analog to Digital

So how does the world move from analog to digital? First of all, it's important to realize that analog paging and cellular networks will not go away overnight. They are likely to be with us for at least the rest of this decade and well into the 21st century. But we are going to see more and more interest in digital cellular, PCNs and analog/digital hybrids. As we move toward the late-1990s, we will see digital networks and PCNs begin to soak up some of the demand that today's analog cellular networks have created.

It is important for countries that are considering building new mobile communications networks to compare cost, consumer demand, and technologies. What may be right for one country or one circumstance may not be right for everyone, but we will, over the course of the next decade, see a transition from today's analog networks to digital cellular and PCN-type technologies. One-way Telepoint systems are already in use in the U.K. and are under construction in other countries.

Within the next two to three years, digital cellular will take its place beside analog cellular as a premium service. it will offer more capacity, clearer signals and enhanced services. CT2/Telepoint services will begin operations. Then we will see the first two-way personal communications networks emerge. The lower equipment cost of PCNs is expected to transform the mobile digital communications industry--and perhaps challenge land-based, corded telephony for supremacy.

Toward the Digital Decade

The benefits of digital over analog are clear: improved clarity, greater capacity, and better data handling capability--at a comparable and, eventually, lower cost. The trend is clear. It is no longer a question of whether the world will adopt digital technologies for mobile communications, but rather a question of when. For the countries of the Asia/Pacific Region, the transitional period of the 1990s--the Digital Decade--offers a unique opportunity to enjoy the benefits of this emerging technology. It is a chance for them to join the rest of the world in riding the wave of digital communications--a wave that will likely lead to greater personal productivity, new economic opportunities, and a more unified, digital communications infrastructure among the great marketplaces and nations of the world.

Connecting the last mile. Data Communications in a mobile environment

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ABSTRACT

Public Mobile Data Service (PMDS) is a telecommunications service based on three proven technologies: cellular radio, X.25 packet switching, and digital radio data communications. By combining these well understood technologies, it is now possible to offer Territory-wide high-speed, error-free wireless data communications to customers.

Hutchison Mobile Data Limited (HMDL) has installed in Hong Kong the world's first mobile data network available to the public. By providing all the complex and expensive radio infrastructure, cell sites, and gateway switching and protocol conversion equipment, HMDL has ensured that small firms and individual end-users can now make use of mobile data facilities with the same ease of interface commonly associated with the PSTN and PPSN.

The components making up a PMDS network are described, and an explanation of radio packet data transmission is given.

The applications made possible by the availability of the PMDS are diverse, and will have a significant impact on the way data is distributed and used. A number of potential uses are examined, and some future possibilities are considered.

1 Nature of Service

The basic products offered to users of the Public Mobile Data Service (PMDS) are a vehicle mounted Mobile Data Terminal (MDT), a hand-held Portable Data Terminal (PDT), and a Radio Frequency Packet Assembler/Disassembler (RFPAD). These units are equipped with their own integral radio units and antennas. The terminals can be programmed to display data entry forms or to check and process data in a particular way before transmission, while the RFPAD acts as a transparent "modem" or PAD with any existing terminal or PC.

Most user's terminals will operate in conjunction with a centralized host computer or applications program. These applications programs enable terminals to communicate data in a specific way depending on the type of application desired.

Not all applications require the use of a centralized applications program however. Many organizations wish only to communicate with an existing host computer system or electronic mail system using existing terminal equipment. In this case, the RFPAD is used to provide wireless connectivity between the organization's host application and the user's terminal or PC.

In addition, the Public Mobile Data System is capable of offering electronic mail, data base storage, and simple dispatch massaging functions for users who do not have access to an application program or host computers. Examples of users of such network offered services may be very small fleets or single users who cannot justify their own in-house applications processor.

2 History

The mobile data communications industry has evolved over the last 15 years from its foundations in the land mobile radio industry. The use of radio channels solely for the purpose of data communications began in the 1960's with applications in traffic light control and utility load shedding systems.

Early applications included the implementation of radio control over residential water heaters to limit peak electricity demand during the winter, and the transmission of information to police vehicles. While these were one-way communications systems, similar concepts were implemented on a two-way basis to monitor and control bus services in metropolitan areas.

The need for people on the move to communicate over the RF with remote computer data bases began to develop in the early 1970's as the use of computers in large enterprises became ubiquitous. As had been typical throughout the history of two-way mobile communications, law enforcement agencies were the early adopters. Mobile data terminals allowed police officers to access centralized vehicle registration, driver's license, and criminal history computer files while on the road.

While these early data products were designed for compatibility with existing voice radio equipment, the applications were typically independent of customers' voice applications. In fact, in many cases these radio data systems were being purchased by customers who had not previously used two-way voice radio.

Manufacturers identified the need for dedicated data systems with enhanced throughput capabilities, and thus more user capacity per radio channel. The radio data system architecture of the 1980's, employs high speed signalling rates (4800 BPS) with substantial error correction. This means that the quality of the transmission is monitored by communications controllers, and when errors due to noise are detected, the communications controller is able to repair the damage automatically by using an error-correcting algorithm built into the transmission protocol.

3 Description of the PMDS

A mobile data communications system typically consists of a number of mobile data communications terminals which communicate through a mobile radio system to a centralized host computer. Such systems allow the two way communication of digital information between personnel in the field and data bases, dispatching centres, or communications networks.

By implementing these systems in the 800 MHz band, it is possible to take advantage of cellular technology to gain the efficiencies of frequency reuse in a wide area system, as well as achieving in-building portable coverage through the high degree of urban multipath in this band.

The terminals are frequency agile, programmable devices and have the capability of formatting or processing information for the terminal operator in the field. In addition, peripheral devices can be connected to the terminals to allow, for example, bar code input of information, printers to produce hard copy output, and automatic vehicle locating devices which can report vehicle location and other operating parameters back to a central location.

In many applications, the terminals communicate with a small computer at a control centre which automates the dispatching and fleet management of field personnel (Computer Aided Dispatch). In other words, the technology is not limited to businesses which run large mainframe computers. Small businesses and individuals can also make use of systems based on relatively inexpensive micro-computers.

HMDL's PMDS is based on three proven technologies in order to provide a convenient, cost effective public network service without the restrictions of wired connections. These technologies are: X.25 packet data communications, cellular mobile radio, and digital radio data communications. The cellular radio network provides the wide-area coverage with high spectrum efficiency through re-use; digital radio technology permits the high-speed transmission of data without error, and X.25 packet switching permits the interconnection of the various radio cell sites, customer sites, and diverse host computers located throughout the world in an efficient and timely manner.

3.1 X.25 Packet Data

HMDL's PMDS incorporates the best principles of proven data networking. All network components communicate using X.25 packet switching.

This means that the PMDS is independent of any application or computer used on the network, and that the PMDS can connect with any other public or private X.25 network around the world. Effectively, this gives the PMDS customer the same reach available to regular data users.

By using packet switching, a large number of users can share a single channel, thus increasing spectrum efficiency dramatically. No other technology can allow as many people to use a single resource simultaneously.

3.2 Mobile Cellular Communications

Conventional mobile radio systems have utilized a single high powered transmitter/receiver to cover a metropolitan area of up to 100 miles in

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diameter.

This single cell configuration combined with limited radio channels allowed only very few simultaneous voice conversations in a major metropolitan area. In addition to the substantial channel congestion this produced, the service also suffered from poor voice quality due to the large service area per cell, and poor in-building coverage for portable units. Cellular technology overcomes these limitations by reusing radio frequencies, and providing better coverage through numerous small cells.

3.3 Digital Radio Data Communications

By using digital rather than conventional analogue techniques, HMDL is able to provide secure, error-free, efficient communication. HMDL's current system supports 400 users per channel using 10 radio channels with a four times re-use pattern. This compares with a loading of 25 subscribers per channel on a cellular voice system.

Along with efficiency, data requires accuracy. On a conventional voice system, subscribers are able to tolerate a certain amount of distortion and fading which they perceive as noise or static. For data, extraordinary measures are necessary to ensure error-free transmission. By using sophisticated error-correction techniques and custom radios, HMDL's system provides an undetected bit-error rate of better than one in ten billion.

4 Network Architecture

4.1 System Description

The PMDS installed by HMDL provides wide area coverage with high system capacity using a multi-cell, multi-user, multi-application approach.

This configuration, as illustrated in Figure 1 provides for a low-cost network which can be easily upgraded as user demand increases. The Network Gateway, which is the connecting node between the radio network and customer application hosts, is available in different sizes, depending primarily on the CPU power of the computer used to run the Gateway software.

The radio portion of the Network is based on proprietary protocols and equipment from Mobile Data International Inc., a Motorola company. This portion of the Network can be thought of as the proverbial "black box" - it is supplied as an engineered system with clearly defined functional requirements. Most of the application development and network management work takes place at the Gateway level, rather than at the RF level.

4.2 Network Gateway

The Network Gateway has been designed as a configurable, centralized interface gateway which provides connectivity between a number of Network User Applications Packages running on geographically separated hosts, and the Public Mobile Data Network.

4.2.1 RF Network Management

The Network Gateway is currently configured as a multi-cell, multi-frequency RF control centre.

This configuration uses continuous carrier with DSMA contention. In addition, Automatic Cell Transfer (ACT) is employed to select the best usable radio channel as a PDT or MDT passes through different radio coverage cells.

The Network Gateway maintains a table which identifies the location (radio site) that the MDT is currently communicating with. When an MDT selects a new RF channel, or cell, it will send a HERE-I-AM (HIA) message. This message is used to update this table.

4.2.2 Channels Supported

The number of channels supported depends upon the size of Network Gateway selected. For each Network Gateway configured in the system the number of channels supported is equal to the number of Communications Controllers at maximum link throughput capacity.

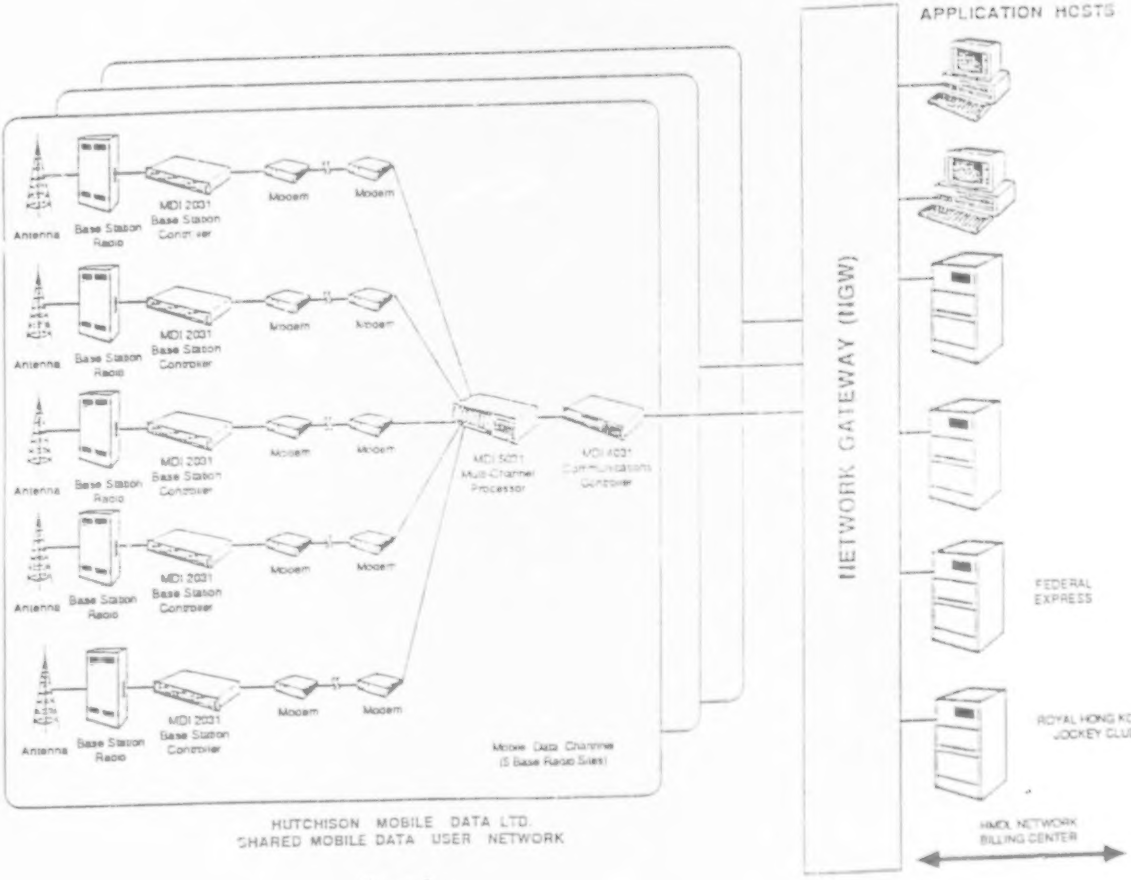

APPLICATION HOSTS
Antenna
Base Station Radio
MDI 2031 Base Station Controller
Modem
Modem
MDI 5031 Multi-Channel Processor
MDI 4031 Communications Controller
Mobile Data Channel (5 Base Radio Sites)
NETWORK GATEWAY (NGW)
FEDERAL EXPRESS
ROYAL HONG KONG JOCKEY CLUB
HMDL NETWORK BILLING CENTER
HUTCHISON MOBILE DATA LTD.
SHARED MOBILE DATA USER NETWORK

Figure 1

4.2.3 Host Interfaces

The Network Gateway has the ability to interconnect a multiplicity of application hosts that have diverse communication protocols and operate at different speeds.

The host interfaces which are currently available for connection to application hosts include X.25, Ethernet, Asynchronous, and SNA.

4.2.3 PDT Application Services

The Network Gateway controls and distributes RF messages to application hosts. The PDT user inquiries are reformatted as required by the receiving application. The responses received from the host are reformatted and directed to the appropriate PDT. This procedure takes place automatically without need for operator intervention.

4.3 Network Gateway Architecture

The Network Gateway hardware is currently based on Digital Equipment's VAX line of computers. Because the software is written in C, and runs under UNIX, other vendors may be used for the Gateway host.

Figure 2 illustrates the current configuration for the Network Gateway. Configurations for higher capacity networks are similar.

Each Network Gateway configuration is based upon a dual redundant hot standby processor arrangement. One processor unit is active and communicates with the backup unit over an Ethernet link. In the event of a failure, the backup unit becomes the active unit. The radio channels are switched over through the digital switch to the active unit, and the application hosts are automatically redirected via the digital switch.

The digital switch provides a clean, efficient environment for interfacing to host applications. This switch is capable of performing hardware protocol conversions at high speed. It is fully programmable, and offers redundant power supplies and interface cards. In addition, the digital switch provides permanent circuit switching of devices between ports of the Gateway processor. This enables the network operator to reconfigure the system resources on-line to maintain efficient service to the network user.

4.4 RF Network Architecture

The channel throughput for a typical system architecture is characterized for Aloha, Slotted Aloha, CSMA and DSMA contention techniques, and these techniques are compared for efficiency in handling short and long message packets.

A mobile radio data communications system is more than just a voice communications system on which data is transmitted. Previously, the performance of a data communications system was often compromised by the limitations of a radio system originally designed for voice transmission.

Efficient contention control is critical if maximum throughput is to be realized in a mobile radio data system. The technique used for sharing the data channel among many users must be a compromise between common voice contention techniques using control tones and techniques such as Aloha and Slotted Aloha used in satellite communications.

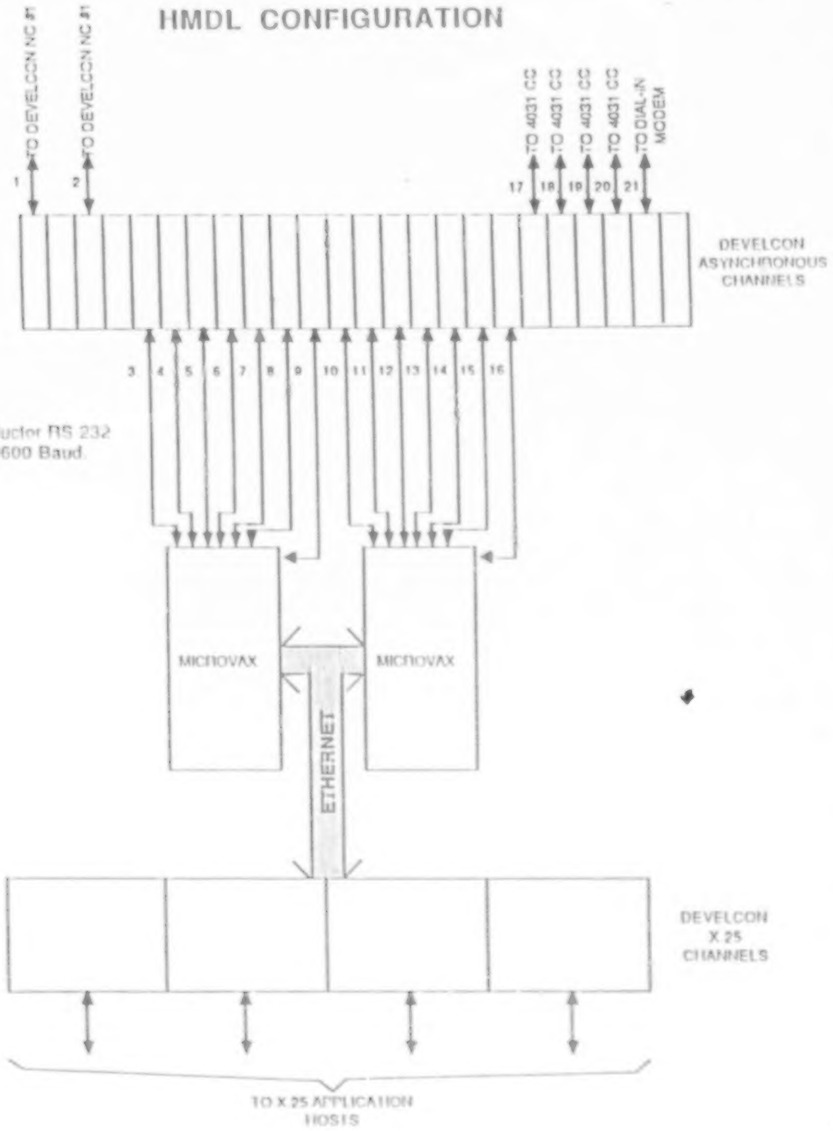
Conceptually mobile radio data communication can be thought of as an extension of a packet data network into the mobile environment. Data packets transmitted on the radio are similar to X.25 Datagrams or X.25 packets for which a virtual circuit has already been established. The key to achieving high system throughput is to minimize the number of relatively short system control packets required for each data transmission, and judicious selection of the channel contention technique.

4.4.1 Typical System Configuration

Figure 3 shows a block diagram of a large system. The public X.25 network is used to switch between subscriber host computer equipment and the Network Gateway. Leased lines are used to connect base station equipment located at the cell sites with equipment located at the Network Control Centre (NCC). Each radio channel at each cell site contains the following equipment:

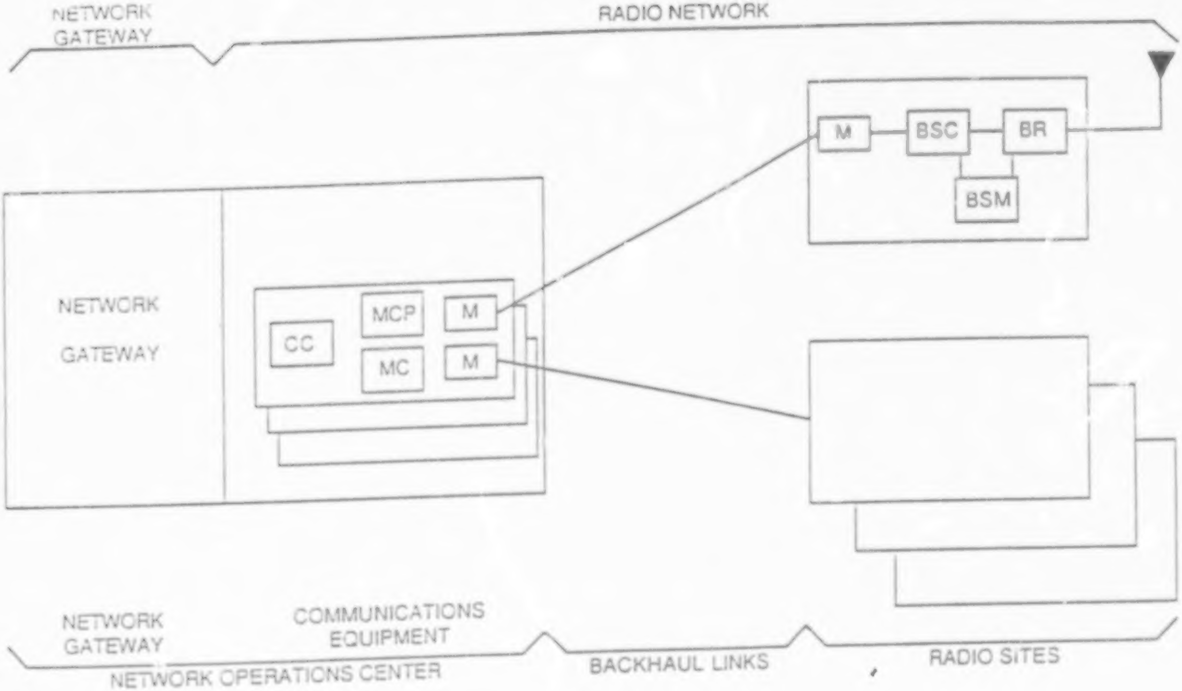
NETWORK GATEWAY EQUIPMENT LOGICAL INTERCONNECT DIAGRAM

HMDL CONFIGURATION


TO DEVELCON NC #1
TO DEVELCON NC #1
TO 4031 CC
TO 4031 CC
TO 4031 CC
TO 4031 CC
TO DIAL-IN MODEM
1
2
17
18
19
20
21
DEVELCON ASYNCHRONOUS CHANNELS
3
4
5
6
7
8
9
10
11
12
13
14
15
16
MICROVAX
MICROVAX
ETHERNET
DEVELCON X 25 CHANNELS
TO X 25 APPLICATION HOSTS

1 - 21 : 25 Conductor RS 232
Asynchronous 9600 Baud.

Figure 2


NETWORK GATEWAY
RADIO NETWORK
M
BSC
BR
BSM
NETWORK
GATEWAY
CC
MCP
MC
M
M
NETWORK GATEWAY
COMMUNICATIONS EQUIPMENT
NETWORK OPERATIONS CENTER
BACKHAUL LINKS
RADIO SITES

SYSTEM TOPOLOGY

Figure 3

Base Station Controller (BSC)

This unit functions as a 4800 bps radio modem and also generates the Busy bit used in the DSMA channel contention technique.

Base Radio Transceiver (Tx/Rx)

This unit is a conventional base radio transceiver. In the system shown a small subscriber may have one host computer in his office connected to twenty or thirty mobile data terminals in different radio cells, through the X.25 public network and the base station equipment shown.

The NCC contains the Gateway host computer, as well as a number of Multi-Channel Processors (MCP) and Communications Controllers (CC)

The MCP acts as a multiplexer between multiple RF cell sites and the CC. The CC unit interfaces to the RF site leased line, formats messages destined for the radio channel into a robust error protected format, detects and corrects errors in messages received from the radio channel, and buffers and acknowledges messages in both directions.

A mobile terminal initiates communications by providing the Communications Controller on its radio channel with the Application ID of its host computer. The Communications Controller then establishes a switched virtual circuit (SVC) to the subscriber host computer. Data communications between host computer and mobile data terminal can then proceed. The SVC is cleared when the mobile moves to a new cell or frequency, or after a period of inactivity.

4.4.2 Control of Contention

Access to a shared channel results in contention for a limited resource. The channel utilization is defined by the level of successful message transmissions relative to the maximum channel capacity.

The simplest scheme for accessing a channel uses no contention control, allowing each mobile to transmit independently of the other mobiles and the state of the channel. Collisions on a pure Aloha channel are frequent and, therefore, the maximum throughput is low. Assuming fixed length message packets transmitted at random with an exponential distribution of inter-arrival times, the channel utilization is given by:

$$S = G e^{2G}$$

G = normalized attempted traffic
S = channel utilization
e = normalized throughput

The maximum channel utilization for a pure Aloha channel is 1/2e = 0.184, which represents a maximum throughput of only 18.4% of the channel capacity.

In a Slotted Aloha contention control scheme, message transmissions are restricted to commence at the beginning of a fixed time slot. Thus, if two or more packets collide, they overlap completely, and only the given time slot is lost. The channel utilization for Slotted Aloha is given by:

$$S = G e^{-G}$$

With Slotted Aloha contention control, the maximum channel utilization is twice that of pure Aloha, 1/e = 0.368. The maximum throughput is 36.8% of the channel capacity.

A much more efficient contention control scheme is based upon preventing additional mobiles from transmitting when the channel is in use. The base system detects when a message packet is being transmitted and signals to the mobiles that the channel is busy. The usual method for sensing the busy condition of a channel is to detect the presence of the carrier signal. This scheme is referred to as Carrier Sense Multiple Access (CSMA).

The performance of CSMA is dependent upon the ability of a mobile to determine the channel status with a minimum of uncertainty. The presence of a message transmission on the channel must be detected and the mobiles signalled with a minimal delay, for during this period additional transmissions may be initiated which will produce collisions. This delay is referred to as the collision interval and is the prime parameter in determining the channel utilization for CSMA. Using the throughput equation modified for application to land mobile radio, the channel utilization for non-persistent CSMA is given by:

$$S = G e^{-aG} / (G(1+a+b) + e^{-aG})$$

a = normalized collision interval
b = normalized busy hang time

The busy hang time is the duration of the delay from the end of a transmission on the channel to the signalling of the channel not busy condition. It represents a period when the channel is available for transmissions, but the mobiles are denied access. The channel utilization is reduced by the busy hang time.

The maximum channel utilization for CSMA is determined by the collision interval (and the busy hang time):

$$S_{max} = S(G,a,b) \,|_{G = G_{max}}$$

$$G_{max} = \frac{\sqrt{3a^2 + 4a + 4ab} - a}{a^2 + 2a + 2ab}$$

In general, CSMA implementations are based upon either true radio frequency carrier detection, or sub-audible tone detection. Carrier detection requires a detection filter tuned to high frequency operation. Sub-audible tone detection filters have a prohibitively long response delay incurred while accumulating energy over a number of tone cycles. In addition, the transmission of a sub-audible tone with each message packet reduces bandwidth available for the message packet.

The MDI system utilizes a contention control technique based upon detection of the digital data in a message transmission. Digital Sense Multiple Access (DSMA) is analogous to CSMA in its operation, but the use of digital data detection provides much better performance by reducing the channel busy detection delay.

The performance of the DSMA contention control scheme is also improved by the use of a digital bit sequence to indicate the channel busy condition to the mobiles. The setting and detection of the digital busy bit is a simple and fast signalling technique that greatly reduces the channel busy signalling delay.

The channel utilization equation given for CSMA also applies to DSMA, only with a reduced value for the collision interval.

4.4.3 Factors Affecting the Collision Interval

For a two frequency full duplex system where the base station is receiving continuously, the total collision interval is made up of the following components:

- mobile transmitter attack time
- propagation delay, mobile to base
- time for base station to integrate data signal to obtain confidence that data is present rather than noise or voice
- time for base station to set busy signal
- propagation delay, base to mobile
- time for mobile to detect busy signal and inhibit transmit function

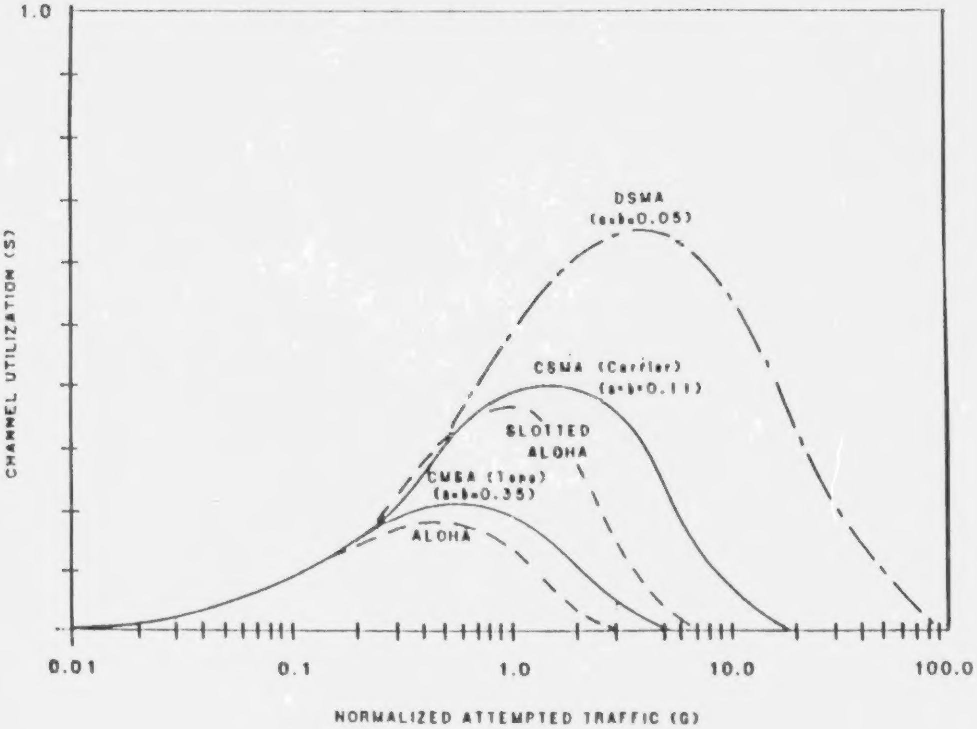
For small collision intervals, the maximum throughput capacity for CSMA or DSMA contention control is far greater than the maximum capacities of Aloha and Slotted Aloha.

Figure 4 shows the channel utilization curves for the contention control schemes described: Aloha, Slotted Aloha, and CSMA and DSMA. DSMA performs better than CSMA because of the reduced collision interval, and better than Aloha and Slotted Aloha because of the improved contention control.

Non-persistent DSMA contention control provides the best channel utilization for small collision intervals. Small collision intervals can be attained by using mobile transmitters with fast attack times, fast busy detection circuitry, and rapid signalling of the channel busy condition. The latter requirement is achieved in the MDI system by using a digital bit pattern to signal the busy condition.

4.4.4 Characterization of Channel Throughput

The performance of non-persistent CSMA or DSMA contention control depends on the duration of the collision interval relative to the length of the



THROUGHPUT AS A FUNCTION OF ATTEMPTED TRAFFIC
FOR VARIOUS CONTENTION TECHNIQUES

Figure 4

transmitted message packets. In a typical system, the collision interval is kept as small as possible, and as an example may be in the order of 15 milliseconds. However, the length of the message packets can typically vary from 500 to 4000 bits, or 100 to 900 milliseconds in duration. Thus, the relative collision interval varies from 15% to 60% depending upon the message length.

The maximum channel utilization for a fixed collision interval depends, therefore, on the length of the message packets. The longer the data packet, the greater the data throughput attainable.

Non-persistent CSMA and DSMA and highly efficient contention techniques provided that the collision interval and the busy hang time can be minimized. In addition best results are obtained when the message packet length is relatively long compared with the collision interval.

5 Customers

Customers for the PMDS include a wide variety of organizations which have a need for:

- instant access to real-time information
- communications with field personnel
- more efficient management of field personnel
- a reduction in the manual reporting of information and associated paperwork
- faster response and improved customer service
- radio coverage over wide areas and inside buildings within cities.

Though such benefits have always been evident with mobile data communications, in the past the complexity and cost of such systems was only practical for well financed organizations with large fleets of field personnel and expensive private radio networks.

However, the availability of the PMDS and recent improvements in the technology make the implementation and adoption of mobile data communications both easier and economically practical for smaller, less, sophisticated organizations.

While organizations in the historic markets of public safety and public utilities have expressed interest in subscribing to a PMDS, a vastly larger base of subscribers exists among private sector organizations. Such organizations have not been able to justify the expense and effort of establishing and maintaining extensive radio communications networks on their own.

Firms involved in courier transport services, field maintenance, financial services, remote inspection, field sales, and wholesale distribution and inventory control have expressed interest in becoming subscribers to the PMDS.

We expect significant growth in the mobile data communications industry because of a number of societal trends and economic factors:

- An increasing awareness within companies of the advantages of efficient fleet monitoring and control.

- Increasing costs of labour and transportation, and heightening competition in all sectors of the economy which is requiring organizations to improve operational efficiency and customer service.

- The desire, and in many cases the necessity for people to be mobile to efficiently perform their jobs (this is particularly true in the service sector of the economy which is currently experiencing rapid growth).

- The increasing adoption of, and dependency on, digital information systems within companies.

- A growing need for increased volumes of information to be communicated, and an increasing need for accuracy in communicated information.

- A growing shortage of radio frequency spectrum in metropolitan areas.

- Improving electronic technologies which provide for smaller, lighter, and lower priced mobile data communications equipment.

As a network operator, we have also added value to the PMDS by providing connectivity between applications and delivery mechanisms - Mobile Data, Mobile Phone, Paging, Fax, and E-mail.

6 References

L. Kleinrock and F. Tobagi "Packet Switching in Radio Channels Part I: Carrier Sense Multiple Access Modes and their Throughput-Delay Characteristics: IEEE Trans. Communications vol. Com-23, No. 12, pp1400-1416, December 1975

AN ADVANCED PAYLOAD CONCEPT FOR PERSONAL, MOBILE AND PRIVATE BUSINESS COMMUNICATIONS

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1. ABSTRACT

The Canadian Department of Communications has been studying options for a government-sponsored satellite payload to demonstrate advanced communications technologies and services. This demonstration payload is intended to achieve two primary objectives: firstly, to prove out new personal and mobile communications concepts and technologies at Ka-band, and secondly, to support demonstrations of advanced private business network services at Ku-band. A potential flight opportunity has developed due to the projected need for Telesat Canada to launch a replacement satellite before the turn of the century.

2. INTRODUCTION

In order to support the preparation of inputs for the Long Term Space Plan being developed by the newly created Canadian Space Agency, the Department of Communications has been studying options for a government-sponsored payload to demonstrate advanced satellite communications technologies and services. A possible flight opportunity has been identified in the 1997 time frame due to a projected requirement by Telesat Canada for a replacement satellite. The forecasted Telesat requirement would be for one half of the capacity of a current Anik-E satellite. In order to assess the feasibility of launching a demonstration payload utilizing the other half of an Anik-E satellite, the Department of Communications awarded a contract to Spar Aerospace Limited in January 1990 to carry out a detailed study of an advanced satellite system to support both personal and mobile communications at Ka-band (30/20 GHz) as well as private business networks at Ku-band (14/12 GHz). Since a major objective of the study was to make it application and service driven, a significant portion of the study was devoted to the identification of new service opportunities.

The assessment of new service opportunities was carried out under three separate sub-contracts. Telesat Canada addressed the Canada/US domestic market, which was the market of primary interest. John A. Collins & Associates addressed the international market as well as the non-Canada/US domestic market. In assessing the international market special emphasis was given to the possible use of the 30/20 GHz band for aeronautical mobile communications. MPR Teltech Limited was responsible for assessing the competitive environment for satellite services arising from terrestrial systems.

The recommended payload concept consists of an integrated dual-band payload which is designed to provide personal and mobile services at Ka-band and advanced private business network services at Ku-band. This payload incorporates a number of advanced satellite technologies including a group demodulator to convert the single-channel-per-carrier (SCPC) frequency-division multiple-access (FDMA) uplink signals from the Ka-band personal/mobile terminals to a time-division multiplex (TDM) downlink, on-board signal regeneration, and baseband switching to support packet-switched data services. The on-board processing capability can provide integrated voice/data/video services with single-hop full-mesh interconnectivity within very small aperture terminal (VSAT) networks at Ku-band by means of a hubless VSAT architecture. The Ka-band and Ku-band portions of the payload are fully integrated through the on-board switch, thereby providing the capability for fully integrated services, such as using the Ku-band VSAT terminals as gateway stations for the Ka-band personal/mobile communications services.

3. NEW SERVICE OPPORTUNITIES

As an increasing number of countries, including Canada, find themselves in the midst of a transition from an industrial or resource-based economy to one based on the provision of value-added information-based services, the need for high quality ubiquitous communications continues to grow. The rapidly expanding availability of low cost computing power and text-based applications has caused an explosive growth in demand for data communications. In the future, a move towards graphics-based applications will fuel demand for even higher speed data or video communications. Against this background, satellite systems must compete with terrestrial service providers. In order to compete effectively, satellite systems must rely on exploiting the following advantages which they have traditionally enjoyed over their terrestrial competitors:

- wide-area coverage enabling efficient point-to multipoint, multipoint-to-point and multipoint-to-multipoint capability
- the ability to reconfigure distribution of bandwidth
- rapid implementation of service into new areas
- low installation cost of a node
- distance insensitivity to cost

Already satellites are losing ground in some of their traditional areas to terrestrial alternatives. For example, the introduction of wideband fibre optic trunks has largely reduced the role of satellites in the provision of heavy-route trunking for voice to one of restoral and back-up of terrestrial networks. However, in other service areas, satellites will be able to either maintain or increase their market share by providing both enhanced services and new service offerings. In the wide-area distribution of TV programming, satellites are likely to remain leaders with the introduction of new services such as high definition television (HDTV). The provision of wide-area thin-route communications in sparsely populated or under-developed regions provides an excellent match for the capabilities of satellite systems. This is a natural service category for regional and domestic systems incorporating spot beams and satellite on-board processing and switching in order to minimize earth terminal costs. In addition, private business networks based on enhanced VSAT terminals capable of providing integrated voice, data and video services can often be introduced by satellite service providers before terrestrial systems can offer comparable ubiquitous services. The provision of land mobile satellite service (e.g. MSAT) is a new service venture with only a limited experimental and service development history. Market studies have shown that there is demand for this service for reasons of efficiency, necessity and convenience. However, experience to date with some specialized new services, such as the Qualcomm Ku-band system, has shown that some of the anticipated demand can be met in a more cost effective manner by non-real-time data messaging systems than by a traditional real-time voice service. Consequently, it seems likely that land mobile satellite services will evolve during the next decade as commercial mobile satellite systems are introduced.

3.1 Personal/Mobile Satellite Communications

In order to restrict the scope of the study to manageable proportions, it was decided at the outset to limit the investigation of personal/mobile communications services to the use of the Ka-band. This was done because one objective of the Department of Communications is to use the demonstration payload as a means to foster the development of Ka-band satellite communications technology in Canada. Because the large attenuation due to rainfall will likely exclude the use of Ka-band for high availability services, such as heavy-route trunking, it was decided to consider the use of this band for services which do not require such high availabilities, such as personal and mobile communications.

Personal communications is a new service concept with a very broadly defined market base. The market assessment predicted a substantial market for personal communications services which would be met primarily by either terrestrial cordless telephone microcellular systems or cellular mobile radio systems because satellite systems cannot provide the ubiquitous access required by a truly personal communications system. This is due to line-of-sight limitations caused by obstacles, such as buildings, in the transmission path. However, it seems likely that the huge capital investment required to install the infrastructure necessary to support a terrestrial microcellular system will restrict this solution to heavily populated urban areas. In North America, where population densities are much lower than in Europe, it will likely be uneconomical to install microcellular systems in rural and remote areas. In rural areas either the cellular mobile radio system or satellites can be used to backhaul personal communications services to the fixed network. In remote areas satellites will likely be the only alternative available for this backhaul service. The degree of penetration that satellites can make into this market niche will clearly be dependent on the cost competitiveness of satellites versus cellular mobile radio in rural and remote areas.

Other possible applications for satellites within an integrated Personal Communications Network (PCN) were also identified. One of these is to provide extension for terrestrial microcellular personal communications systems. Another possibility is to provide a "Satellite Backbone Service" for providing trunk interconnection between terrestrial personal communications services base stations. Advanced satellites incorporating on-board switching and spot-beam antennas could provide this service over wide geographic areas with full-mesh interconnectivity. Due to the large bandwidth available at Ka-band, a satellite system can provide a variety of wideband services, such as ISDN and video, which cannot be accommodated by terrestrial wireless systems in the lower frequency bands because of bandwidth limitations. Another possible market niche for satellites is in mobility management where the broadcast and wide-area coverage capabilities of satellites would provide a natural advantage for paging. There may also be an opportunity to provide some direct-to-subscriber services to hand-held communicators to support resource exploration and other wilderness activities in remote areas. Although a number of previous studies by the Jet Propulsion Laboratory (JPL) have addressed the use of a hand-held communicator for direct access to a Ka-band satellite [1-3], the present study identified the following four potentially serious limitations with this concept:

- possible radiation health hazard
- antenna pointing problems
- battery life limitations
- call notification problem

The recognition of these potential limitations of a hand-held satellite personal communicator led to the concept of using satellite-based relay terminals in rural and remote areas for backhauling conventional cordless telephones into the public switched network.

Until recently mobile satellite communications has been the exclusive domain of the maritime community served by Inmarsat. This service started with the Inmarsat Standard A terminal which provided analog voice and telex. This terminal will be superseded in 1992/93 by the all digital Standard B full-service terminal. In order to provide a lower cost service to the small maritime user, Inmarsat has recently introduced the all digital Standard C terminal to provide a low bit rate packet message service. Inmarsat is now planning to expand its user base by offering both aeronautical and land mobile satellite services. For the aeronautical users, the Future Air Navigation System (FANS) being developed by the International Civil Aviation Organization (ICAO) will use satellites to provide both communications and position reporting for the provision of in-flight safety services. Public correspondence for airline passengers, which is already being provided by various terrestrial suppliers, such as GTE Airfone, on trans-continental routes will likely be available to trans-oceanic passengers via satellite in the near future since the airline companies see this service as a means of generating early revenue to pay for the introduction of satellite communications technology. Land Mobile Satellite Service (LMSS) including data messaging and positioning have been introduced recently by Geostar and Qualcomm. The MSAT mobile satellite program, which is being jointly sponsored by Telesat Mobile Incorporated (TMI) in Canada and the American Mobile Satellite Corporation (AMSC) in the USA, will begin providing service in 1994 using high-power spot-beam L-band satellites. Further competition in the LMSS arena could come from several Low Earth Orbit (LEO) systems that have been proposed recently by various companies including Orbcomm, Starsys and Motorola. Of these the Iridium system proposed by Motorola, which consists of 77 LEO satellites, is by far the most ambitious.

Within the above environment, which clearly suggests that the evolution of mobile satellite services during the next decade will be very dynamic, it is necessary to identify some candidate services for demonstration on a Ka-band payload. Since the maritime mobile satellite service is well established and well served by Inmarsat, the identification of new services will be limited to the aeronautical and land mobile application. The provision of public correspondence to passengers in trans-oceanic commercial aircraft would seem to be a natural service to consider since these aircraft fly above the clouds and, therefore, the attenuation caused by rainfall at Ka-band will not be a problem. In addition it seems likely that, as the number of users grows, or as requirements for wideband services emerge, the existing L-band systems will be unable to meet the demand because of bandwidth limitations. In the land mobile area, a Ka-band satellite could be used either to extend terrestrial cellular mobile radio services or to provide wideband services that cannot be accommodated at L-band.

3.2 Advanced Private Business Networks

Business today relies increasingly on its ability to move large amounts of information quickly. Because of the common carriers' massive investment in equipment and transmission facilities, they may not be either capable or willing to respond to new business requirements in a timely manner with the latest that technology has to offer. In addition companies increasingly wish to exercise more direct control over the communications networks on which their very existence depends. Consequently, corporate communications managers are increasingly turning to private networks because they offer autonomy, security and added value. Satellite-based private business networks generally fall into two categories: VSAT data networks or time-division multiple-access (TDMA) integrated digital networks.

During the 1980s the emergence of VSAT technology created a whole new industry. VSAT networks are typically implemented at Ku-band employing many small (1.8m - 2.4m antennas), low-cost (under $20K), customer-premises earth stations that provide direct low-speed interactive data services between remote locations and a central processing facility. The central processing facility is connected to the network by a large (6m antenna), expensive ($1M-$2M) hub earth station. Consequently, the VSAT architecture is constrained to operate in a star configuration with no direct communications possible between remote locations. VSAT data networks are a highly attractive alternative to terrestrial leased lines, multidrop facilities or the public packet network when a low-speed data service is required between a central facility and a large number of widely scattered locations and the traffic pattern is highly bursty or interactive. VSAT networks, however, cannot provide private network backbone services such as bulk data transfer, two-way video conferencing or voice services efficiently because of the limitations imposed by the low available data rates and the star topology.

First generation TDMA systems were designed to increase the number of voice channels that a single satellite transponder could support for heavy-route trunking. This increase was achieved by a combination of two features. The first resulted from the use of a single carrier in the satellite transponder which allowed the travelling-wave tube amplifier to operate at saturation, thereby gaining a 6 dB power advantage. The second feature resulted from the TDMA digital structure which allowed the easy implementation of digital speech interpolation which doubled the traffic capacity. With the decline in the trunking role for satellites and the emerging need to support thin-route business applications, a second generation TDMA system was developed which was designed to share a satellite transponder with other services. Besides running at lower data rates, these systems introduced innovations such as carrier hopping, block-coded Forward Error Correction (FEC) and Demand-Assigned Multiple-Access (DAMA) systems all of which were designed to reduce the size of the earth station required to support a typical private business network traffic profile. The current third generation of TDMA equipment extends the functionality of this technology to support business networks. By utilizing powerful digital signal-processing modem technology, convolutional FEC techniques, uplink power control and network management it provides a system capable of supporting T1 type networks on small (3.7m antenna) earth stations. TDMA-based networks operate in a mesh configuration with no central control earth station. By supporting a fully integrated digital network providing a complete range of backbone services including voice, data and video, TDMA-based networks provide a cost-effective alternative to equivalent terrestrial facilities. [4] TDMA's greatest advantage over its terrestrial competition is its ability to redistribute bandwidth over the network in response to varying traffic demands at no extra cost to the user.

Having described the current situation, it is now a question of identifying what developments are required to enhance the competitive position of satellite communications in future private business networks. VSAT technology has been successful for three main reasons:

- it reaches locations not served by terrestrial facilities
- it provides a uniformly reliable network
- it has proven to be cost effective

However, the ability of VSAT systems to meet the needs of many corporate customers is limited by

- a star network topology which cannot support single-hop voice service between VSATs
- low data rates which cannot provide high-resolution video conferencing
- an inability to provide a truly integrated digital service

TDMA-based satellite business networks overcome these limitations of VSAT technology. Unfortunately, today's TDMA technology is expensive. In order to enhance the competitiveness of TDMA business networks, what is needed is TDMA capability at VSAT prices! To achieve this goal, satellite technology must evolve from the traditional bent-pipe transponder operating with wide-area coverage antennas to an on-board processing payload combined with spot-beam antennas. On-board processing encompasses two major elements, each performing separate functions; these are signal regeneration and baseband switching. Signal regeneration provides the capability to:

- separate uplink and downlink access protocols
- change data rates between uplinks and downlinks
- prevent uplink noise from adding to downlink noise

- implement separate uplink and downlink error correction
- implement switching on the baseband information

Baseband switching is necessary to restore the connectivity of a spot-beam payload to that of a global-beam configuration.

The use of on-board processing and spot-beam antennas to reduce the cost of the earth station is not a new concept. The NASA Advanced Communications Technology Satellite (ACTS), which is scheduled for launch in 1992, will provide a major advancement in this area of satellite technology. However, first generation on-board processing systems, such as ACTS, have been designed primarily to support trunk voice traffic by providing the following features:

- circuit-switched architecture
- high speed carrier operation
- single user group network management

If on-board processing systems are to support the multi-user, integrated services expected in advanced private business networks, the following features need to be developed for second generation on-board processing systems:

- packet-switched architecture
- group demodulators in the satellite to handle multiple low data rate users
- multiple user group network management

Advanced private business networks implemented using second generation satellite on-board processing systems will be able to support a full range of integrated digital services and will employ sophisticated two-level network management systems in order to provide a degree of autonomy and control to each user group. [5]

4. DEMONSTRATION PAYLOAD CAPABILITIES

The specific requirements for the demonstration payload are now defined. The current concept is intended to achieve two primary objectives:

1) to prove out new personal and mobile communications concepts and technologies at Ka-band

2) to support demonstrations of advanced private business network services at Ku-band

The Ka-band portion of the payload will provide a data messaging services, digital voice and data communications via two 0.6 degree spot-beams. The network architecture will consist of one gateway per beam for connection to the public-switched telephone network (PSTN). The baseline multiple-access method is to use single-channel-per-carrier (SCPC) frequency-division multiple-access (FDMA) uplinks at Ka-band from user terminals and a time-division multiplex (TDM) downlink also at Ka-band to user terminals. The feeder links between the satellite and the gateways will use the multi-frequency time-division multiple-access (MF/TDMA) structure of the business network in the Ku-band. The proposed modulation scheme is phase shift keying (PSK) with rate-1/2 convolutional coding and Viterbi decoding. The demonstration payload has been sized to support the following number of SCPC uplink channels per beam:

Uplink Data Rate	Number of Channels
4.8 kbps	16
64 kbps	16
144 kbps	8

The TDM downlink uses a data rate of 84 kbps to support the 4.8 kbps channels and a rate of 5.4 Mbps to support the 64 kbps and 144 kbps channels. The SCPC uplinks are generated by the following different types of terminals:

1 - Personal Messager
  - 50 word message service @ 4.8 kbps
  - 5.1 cm x 5.1 cm patch antenna

2 - Hand-Held Voice Communicator
  - 4.8 kbps duplex digital voice
  - 5.1 cm x 5.1 cm patch antenna

3 - Portable Relay System
  - 4.8 kbps duplex digital voice
  - 5.1 cm x 5.1 cm patch antenna

4 - F[illegible]d Relay System
  - [illegible].8 kbps duplex digital voice
  - 5.1 cm x 5.1 cm patch antenna

5 - Mobile Service Terminal
  - 4.8 kbps digital voice & messaging
  - 5.1 cm x 5.1 cm patch antenna

6 - Fixed Enhanced Terminal
  - 64 kbps digital voice & data
  - 15 cm diameter dish

7 - ISDN Terminal
  - 144 kbps (2B + D) ISDN service
  - 30 cm diameter dish

A number of these concepts, which are illustrated in Figure 1-1 to 1-7, are similar to previous work published by JPL [1-3] and the Communications Research Laboratory (CRL). [6-8]

The Ku-band portion of the payload will provide advanced private business network services via a multi-beam antenna system that provides four elliptical beams covering Canada and the continental United States. It was decided to implement this service application at Ku-band in order to take full advantage of the inexpensive microwave components and sub-systems already available for VSAT terminals. The network architecture will consist of one Network Control Centre (NCC) for each sub-network, a Network Operations Centre (NOC) and a Satellite Operations Centre (SOC). The multiple access method will be MF/TDMA which will operate at a data rate of 3.2 Mbps on the uplinks and 25.6 Mbps on the downlinks. The proposed modulation technique is quadrature phase shift keying (QPSK) with rate-1/2 convolutional coding. The demonstration payload has been sized to support 16 channels per beam on the uplink and 2 channels per beam on the downlink.

The network management of the Ka-band personal/mobile service is performed entirely in the Ku-band system. Therefore, it is totally integrated into the NOC/NCC structure. Any sub-network controlled by a NCC may be exclusively offering Ku-band business service or personal/mobile service in the Ka-band. Alternatively a sub-network might offer a mixture of fixed and personal/mobile services thus allowing users in these networks to cover the broad range of a corporation's activities.

5. DEMONSTRATION PAYLOAD

A possible flight opportunity has developed in the 1997 time frame using one half of the capacity of a current Anik-E satellite. The first two Anik-E satellites will be launched in 1991 as replacements for two Anik-C and two Anik-D satellites. The Anik-E spacecraft is a large, high-power dual-band, three-axis stabilized satellite using a GE 5000 series service module. [9] The payload of twenty-four C-band channels and sixteen Ku-band channels is powered by a deployable solar array that provides nearly 4 kW of power at the end-of-life. Since the Telesat projected requirement is for half of an Anik-E satellite, the payload under study has been sized to fly as the other half of a possible Anik-E3 satellite.

The demonstration payload currently under study is a combined Ka-band/Ku-band payload as shown in simplified form in Figure 2. As can be seen, the demonstration payload is completely separate from the host commercial payload. The Ka-band portion of the demonstration payload provides coverage of Canada and the continental United States by means of two steerable spot beams as shown in Figure 3 for an orbital location of 107.5°W. The Ku-band portion of this payload provides four elliptical beams covering Canada and the continental United States as shown in Figure 3. The Ku-band beams are power weighted towards Canada to compensate for the increased space loss at the lower elevation angles encountered at higher latitudes and to assist in the co-ordination process with Mexico in the standard Ku-band. Figure 4 shows the spacecraft configuration for the demonstration payload. The two-beam Ka-band antenna and the four-beam Ku-band antenna can be seen side by side on the earth facing panel. The two larger antennas that fold out from the sides of the spacecraft are the host commercial payload C-band and Ku-band antennas.

A more detailed block diagram of the demonstration payload is shown in Figure 5. The 30 GHz receive antenna has a diameter of 1.25m and a beamwidth of 0.6° which provides and edge-of-coverage (EOC) gain of 45.5 dBi and a EOC G/T of 15.4 dB/°K. The 20 GHz transmit antenna is cross polarized and fully overlapped with the receive antenna. Because of head-room limitations caused by the stowed main reflectors for the host commercial portion of the payload, the transmit antenna diameter is limited to 0.85m which corresponds to a beamwidth of 1.3°. When combined with a 20 Watt travelling-wave tube amplifier (TWTA), this results in an equivalent isotropic radiated power (EIRP) of 53 dBW per channel at EOC. The Ku-band private business service is provided by four beams using a 1.0m dual-gridded reflector which provides a peak gain of 39.0 dBi and an EOC gain of 31.0 dBi for both transmit and receive. This antenna gain provides an EOC G/T of 2.4 dB°K and an EOC EIRP of 39.0 dBW per channel using a 20 watt TWTA.

From Figure 5 it can be seen that the demonstration Ka- and Ku-band payloads are interconnected at baseband in the circuit/packet memory switch. It is through this switch that the Ka-band personal/mobile links are connected to the Ku-band feeder links, thereby enabling the VSAT terminals to act as gateway stations for the personal/mobile service. Both the Ka-band and Ku-band payloads use group demodulators to demodulate and demultiplex the multiple uplink signals. There are two methods for implementing a group demodulator; one is an analog approach based on the chirp Fourier transform realized by means of surface acoustic wave filters, and the other is an all digital approach using a digital transmultiplexer. [10] Although the technology to be used to implement these group demodulators is still under study, the baseline approach is to use a digital transmultiplexer implementation based on the polyphase fast Fourier transform.

The mass budget for the combined Ka/Ku-band demonstration payload is given in Table 1. The total estimated mass, including the host payload, equals 471 kg allowing fuel for a life time of more than 10 years. The power budget given in Table 2 shows a margin of over 300 watts. These preliminary estimates show that the proposed demonstration payload is limited by mass and not by power. Consequently, further work aimed at enhancing the capability of the demonstration payload will concentrate on reducing the payload mass.

6. FUTURE PLANS

The integrated services Ka/Ku-band payload concept described in this paper resulted from an initial study carried out by Spar Aerospace Limited under contract to the Canadian Department of Communications. Arrangements are now being completed for a more detailed follow-on contract study with Spar Aerospace that will address a number of key areas in considerably more detail over a period of sixteen months. Specific areas to be covered in the follow-on study are:

1) The definition of user requirements, for business networks and personal/mobile services, and the definition of the range of customer equipment.

2) The derivation of detailed architectural requirements for the system and overall requirements for units in the system. In particular, this work will consider the network management, signalling and synchronization requirements and develop the modelling tools required for on-going analysis.

3) The investigation of technology and configuration options for the core units of the system which are the on-board processing group demodulator and the baseband switches.

4) The full analysis of the host mission parameters to ensure maximum demonstration flexibility compatible with available accommodation on the host spacecraft.

5) Other spacecraft configurations intended to enhance the capability of the Ka-band mission and to cater for the possible use of an alternative host spacecraft.

6) Preliminary design work for advanced ground terminals including both the personal/mobile Ka-band terminals and the baseband units for the Ku-band advanced private business VSAT terminals.

In parallel with this follow-on study, the Department of Communications will be trying to identify possible international partners to participate in the design, development and utilization of this advanced integrated-services dual-band demonstration payload.

7. REFERENCES

[1] M. K. Sue, A. V. Vaisnys and W. Rafferty, A 20/30 GHz Personal Access Satellite System Study, 38th IEEE Vehicular Technology Conference, June 1988.

[2] P. Estabrook, et al., A 20/30 GHz Personal Access Satellite System Design, International Conference on Communications, Boston, June 1989.

[3] M. K. Sue, et al., A Satellite-Based Personal Communications System for the 21st Century, 2nd International Mobile Satellite Conference, Ottawa, June 1990.

[4] B. P. Wong and P. Garland, Cost Effectiveness of Fully Meshed Satellite-Based T1 Networking, Canadian Satellite User Conference, Ottawa, June 1989.

[5] F. J. Osborne, P. J. Garland and I. Streibl, Next Generation Satellite Communications Networks, INTER COMM 90, Vancouver, October 1990.

[6] M. Shimada, et al., Millimeter Wave Personal Radio Using an Advanced Communications Satellite, IEEE Communications Magazine, Vol. 22, No. 9, September 1984.

[7] S. Isobe, et al., Personal Satellite Communications Experiment for Future Systems in Asia-Oceanian Region Using Millimeter-Wave, Pacific Telecommunications Council, 10th Annual Conference, Honolulu, February 1988.

[8] S. Isobe, et al., Experimental Personal Satellite Communications System Using Millimeter- ave for Asia-Oceanian Region, Journal of the Communications Research Laboratory, Vol. 35, No. 145, July 1988.

[9] E. Bertenyi, Telesat Canada's Anik-E Spacecraft, Canadian Satellite User Conference, Ottawa, June 1989.

[10] C. Loo, E. J. Hayes and J. G. Chambers, On-Board Processing in Future Communications Satellites, Canadian Satellite User Conference, Ottawa, June 1989.

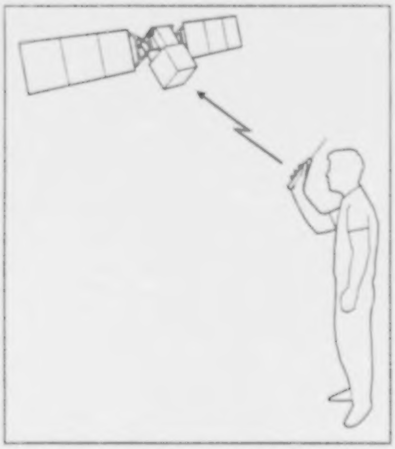

FIGURE 1-1: PERSONAL MESSAGER TERMINAL

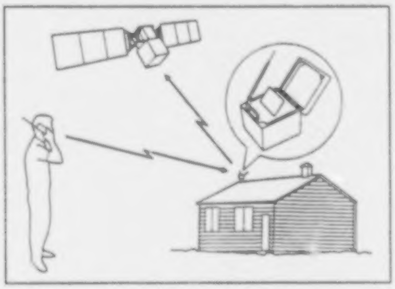

FIGURE 1-3: FIXED RELAY SYSTEM

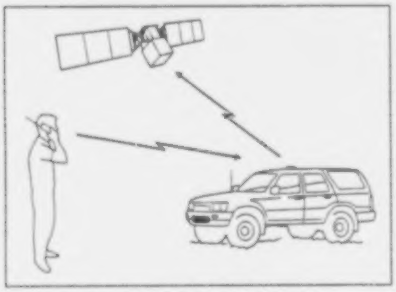

FIGURE 1-5: MOBILE RELAY SYSTEM

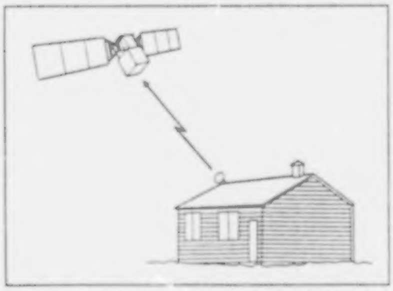

FIGURE 1-7: FIXED ENHANCED TERMINAL

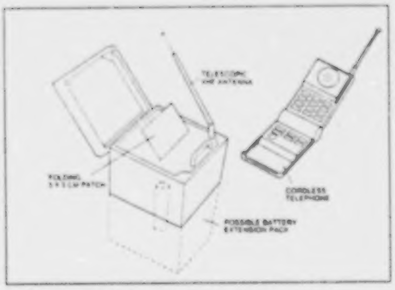
TELESCOPIC VHF ANTENNA
FOLDING 5 X 5 CM PATCH
CORDLESS TELEPHONE
POSSIBLE BATTERY EXTENSION PACK

FIGURE 1-2: RELAY SYSTEM

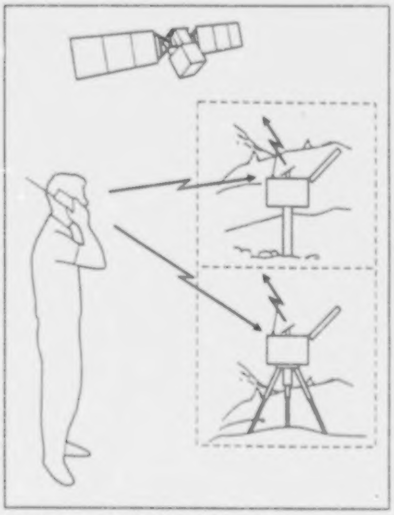

FIGURE 1-4: PORTABLE RELAY SYSTEM

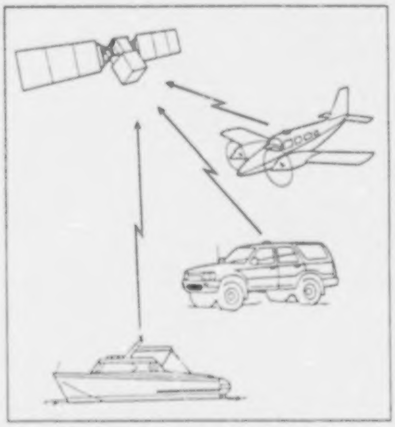

FIGURE 1-6: MOBILE SERVICE TERMINAL

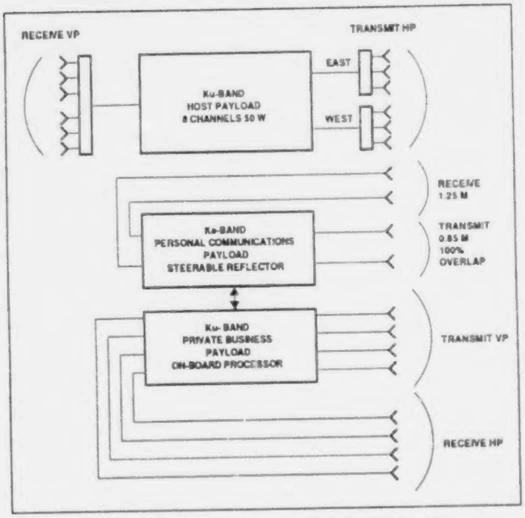
RECEIVE VP
TRANSMIT HP
Ku-BAND
HOST PAYLOAD
8 CHANNELS 50 W
EAST
WEST
RECEIVE
1.25 M
Ka-BAND
PERSONAL COMMUNICATIONS
PAYLOAD
STEERABLE REFLECTOR
TRANSMIT
0.85 M
100%
OVERLAP
Ku- BAND
PRIVATE BUSINESS
PAYLOAD
ON-BOARD PROCESSOR
TRANSMIT VP
RECEIVE HP

FIGURE 2: SIMPLIFIED PAYLOAD BLOCK DIAGRAM

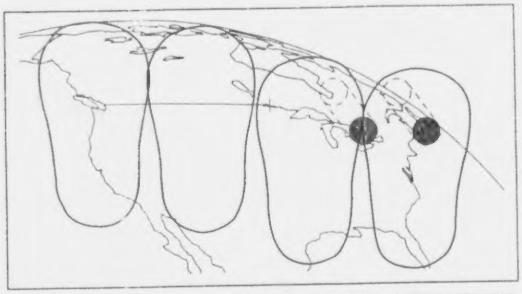

FIGURE 3: DEMONSTRATION PAYLOAD COVERAGE PATTERNS

TABLE 1: DEMONSTRATION MODEL MASS BUDGET

	Mass (kg)	
Host ANIK E3 Payload		217
C-Band Antenna	48	
Ku-Band Antenna	45	
C-Band Transponder	58	
Ku-Band Transponder	66	
Demonstration Payload		254
Ku-Band Antenna	14	
Ka-Band Antenna	16	
Ku-Band RF Hardware	90	
Ka-Band RF Hardware	43	
Digital Hardware	79	
Frequency Sources	12	
Total		471
Life Time (Y)		10.6

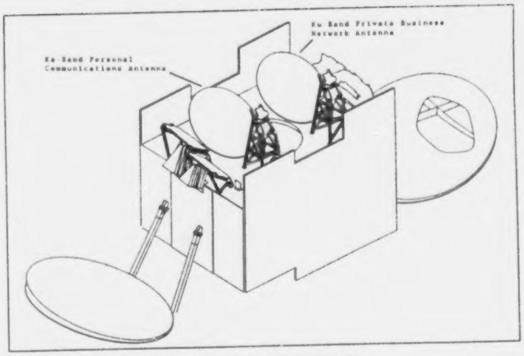
Ku Band Private Business
Network Antenna
Ka-Band Personal
Communications Antenna

FIGURE 4: SPACECRAFT CONFIGURATION

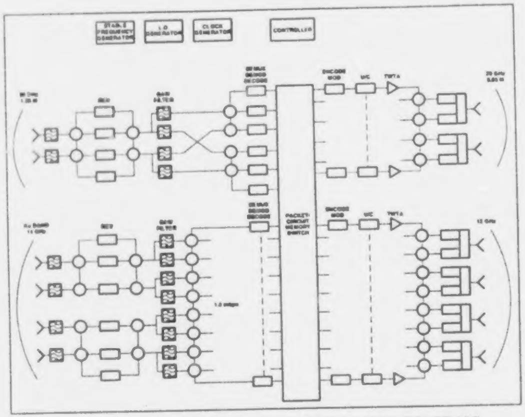
STABLE FREQUENCY GENERATOR
LO GENERATOR
CLOCK GENERATOR
CONTROLLER
RCV
BAW FILTER
DEMUX DEMOD DECODE
ENCODE MOD
U/C
TWTA
PACKET-CIRCUIT MEMORY SWITCH

FIGURE 5: DEMONSTRATION PAYLOAD BLOCK DIAGRAM

TABLE 2: DEMONSTRATION MODEL POWER BUDGET

	Power (watts)		
Host ANIK E3 Transponder	1341		
Baseband Processing Transponder			
Ku-Band	544		
Ka-Band	272		
Processing Hardware	180		
Frequency Generators	30		
Payload Total	2367		
	Summer Solstice	Autumn Equinox	Eclipse
Spacecraft Capability	2685	2685	2693
Margin	318	318	326

NCOM : A STEP TOWARD TELECOMMUNICATIONS MANAGEMENT NETWORK

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Abstract

This paper reviews the recent trend for the standardization of telecommunications network management spurred by the growing multi-vendor environment, and discusses possible NEC's approaches to cope with this trend while utilizing the existing products.

1. Introduction

Complexity of stored program control and digital technology has made telecommunications networks more difficult to manage. Shortage of resources, especially skilled operation and maintenance personnel, has raised resource costs, resulting in the centralization of network analysis. In addition, there is an increasing need for integrate network management as well as for efficient operation and maintenance of individual telecommunications systems. Because of this trend for integrated network management, the interrelations among tasks of telephone companies, such as subscriber registration, network design and monitoring, and maintenance and billing management, tend to be intensified while the organization of telephone operating companies is becoming more complex and diversified. Efficient use of complex telecommunications network has a significant impact on the profitability of telephone services.

This paper introduces NEC's Computerized Operation and Maintenance (NCOM) system, which is an on-line computer used for improving telecommunications network effectiveness and efficiency. NCOM is especially suited for the telephone company's needs of scale and function, which can be provided by using a distributed processing system and by combining the costs of hardware and software modules effectively, This system has been designed to conform to the emerging Telecommunications Management Network (TMN) standards currently under discussion by CCITT.

2. Recent Trends for TMN and TMN-Related Problems

This section describes the recent trends for the TMN and the related problems.

2.1 Background behind CCITT's effort toward standardization

With a multi-vendor environment emerging as a result of combining a number of network capabilities such as ISDN, telephone network and data network, there has been a rapidly growing need for standardized network management in view of the social influence of network failures and the increasing maintenance cost. In 1985, two working groups of CCIT, SGIV and SGXV, introduced the TMN to promote network management standardization. Since then, many studies were made which were followed by there recommendations announced in 1988. These recommendations are:

(1) M.30 "Principles for a Telecommunications Management Network (TMN)"

(2) Q.513 "Exchange Interface for Operation, Administration and Maintenance"

(3) G.711 "Q-Interfaces and Associated Protocols for Transmission Equipment in the Telecommunications Management Network (TMN)"

2.2 Outline of TMN

Figure 1 shows the relationship between the TMN and the telecommunications network. As shown in this figure, the TMN collects management information from exchanges, transmission systems and operation systems, and displays the collected information at work stations, Figure 2 shows the physical architecture of the TMN. Within the TMN, reference points are defined among functional models and network elements. Since the TMN is required to exercise integrated management of a combination of heterogeneous equipment and systems, it employs a hierarchical architecture and connects the equipment and sytems using mutually agreed protocol to offset the differences among the functional models and network elements.

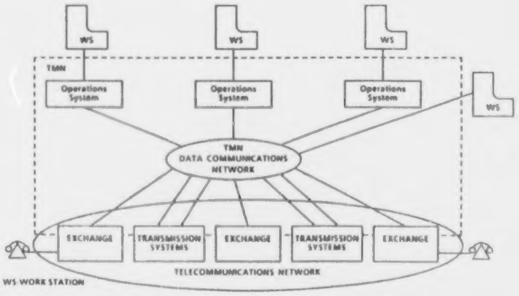

FIGURE 1 RELATIONSHIP OF TMN TO TELECOMMUNICATIONS NETWORK

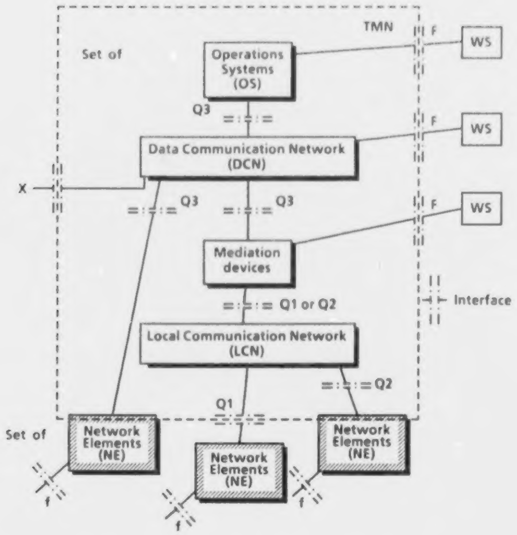

FIGURE 2 GENERAL PHYSICAL ARCHITECTURE FOR TMN

2.3 Methodology of TMN standardization

The standards for the TMN must be so determined that the management functions of the TMN and the services implemented by using combinations of these functions will meet the required specifications. Now, studies are being made for an effective standardizing methodology. The methodology proposed at the moment will cover two types of tasks. One type includes functional tasks that determine the interface requirements. The other type includes protocol tasks that determine groups of protocols meeting the interface requirements.

One important fact about the TMN standards is that they increase in number as new management functions are added to the network. It is, of course, not desirable that the number of standards increases more than necessary. The proposed standardizing methodology will determine necessary and sufficient standards automatically.

2.4 Mediation devices

The proposed standardizing methodology will involve a process called mediation. The purpose of mediation is to provide an efficient means of transmitting management information among operations systems and network elements. One example of the mediation functions is protocol conversion, which makes adjustments between the protocol used by the operations systems and those of the network elements.

2.5 OSI-based protocols and problems

The Q3 protocols under discussion by CCITT are based on the Open System Interconnection (OSI) protocols. These protocols assume a distributed network environment, where distributed individual elements of the management activities are called management process. The management activities include Fault Management (FM), Configuration Management (CM), Performance Management (PM), Accounting Management (AM), and Security Management (SM). These activities are manipulated using managed objects.

For a specific management interaction, the management process performs one of two roles: manager or agent (client-server model). When performing the manager role, the process manages an associated managed object. As an agent, it executes directives issued by the manger.

The OSI protocols use a layered architecture for data transmission. Messages processed in this architecture contain overhead information. Processing this information consumes part of the processing capability of the network, degrading the network performance.

Another problem about the OSI protocols is that none of the existing standards setting organizations (CCITT, OSI Network Management Forum, Bellcore and ANSI T1) has yet defined a complete message set. Because of this lack of the complete message set, the interoperability between the network management system and different types of network elements has not yet been implemented.

3. NEC's Computerized Operation and Maintenance System (NCOM)

3.1 NEC's approaches toward TMN

The TMN is required to execute integrated management of a wide range of equipment and systems, from analog devices to high-performance, highly intelligent digital devices, which have many different functions such as data transmission and switching. For efficient management of network resources, NEC proposes a three-level network management architecture as shown in Figure 3. The three levels of this architecture are individual network element management (level 1), subnetwork management (level 2) and integrated network management (level 3).

Level 1 is the bottom level management. Each individual network element executes self-control by means of its management functions, such as trouble detection, routing and diagnosis.

Level 2 is the individual subnetwork management. Subnetworks include transmission systems, circuit switching systems and packet switching systems. In level 2, each subnetwork has interface with the level 1 management and is given totally individual management. The level 2 management satisfies all the management requirements without any higher level management.

Level 3 is the top level management. Integrated network management is executed by controlling network elements of level 1 through the level 2 subnetwork management.

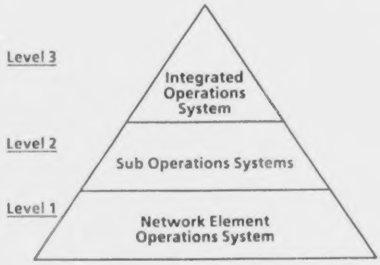
Level 3
Integrated Operations System
Level 2
Sub Operations Systems
Level 1
Network Element Operations System

FIGURE 3 NEC NETWORK OPERATIONS SYSTEM ARCHITECTURE

Figure 4 shows NEC's approaches toward the implementation of the TMN in three steps. The current step is step 1, where the NCOM and each network element are connected using NEC's proprietary protocol. In step 2, the NCOM (NCOM200) will serve as the mediation device to perform protocol conversions in the TMN and will be connected to the operations system using the Q3 protocol. In step 3, each individual network element will be able to operate on the Q3 protocol and, as described by the CCITT models, each network element will be directly connected to the operations system via the data communications network. This system architecture allows economical system enhancement for TMN implementation without discarding any of the old equipment.

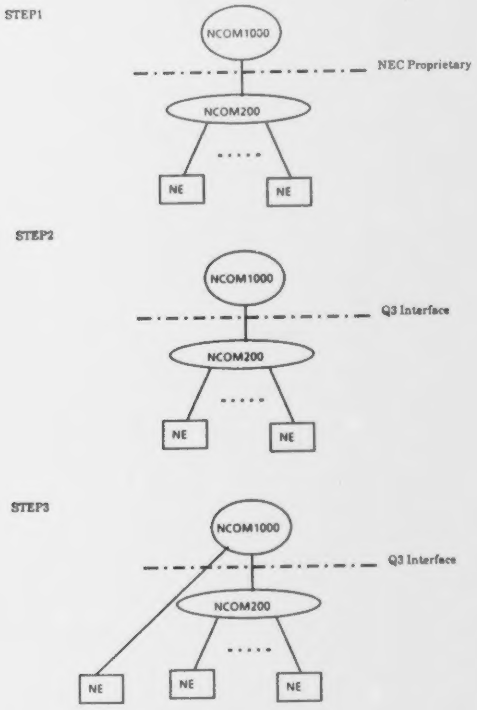

FIGURE 4 NEC 'S APPROACH ES TOWARD THE IMPLEMENTATION OF THE TMN

3.2 Outline of NCOM

The NCOM system has been developed for the NEAX61 digital switching systems. The following types are available:

- NCOM300

NCOM300 is a high-performance operations system that operates on NEC's general-purpose computer system called ACOS. With the Relational Data Base Management System (RDBMS) built in, this system has an excellent capability to process statistical and other data

- NCOM200

NCOM200 is a centralized operation and maintenance system based on packet switching system. This system has a superior data transmission capability and is capable of supporting many different protocols. Its distribute processor architecture allows easy system configuration design that matches the size of the company. By adding NCOM1000 (described below) to the system, NCOM200 can process statistical and other data and implement various operations system functions using the RDBMS.

-NCOM1000

NCOM1000 is an application software jointly developed by NEC and CBIS (Cincinnati Bell Informations System), one of the affiliates of Cincinnati Bell. With its design based on the affluent experiences of these telephone companies, NCOM1000 operates under the UNIX, Oracle and X-Window programs, and ensures efficient software operation that is independent of the hardware restrictions.

NEC has introduced NCOM200 and NCOM1000 for gradual implementation of the TMN. NCOM200 can be installed for increased transmission capability in the system configuration accommodating either NCOM300 or NCOM1000.

Figure 5 shows the physical architecture of the NCOM within the TMN.

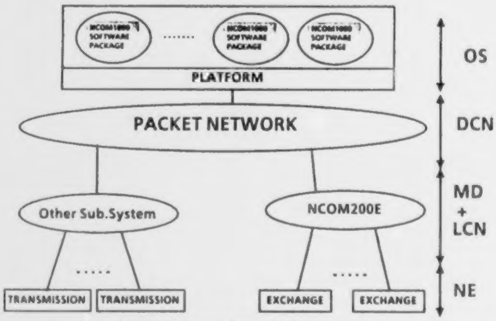

FIGURE 5 NCOM PHYSICAL ARCHITECTURE

3.3 NCOM System Configurations

(1) NCOM200

As shown in Figure6, NCOM200 system employs a distributed processor architecture to implement each function individually.

Each Processor is connected to a duplicated optical loop bus. The system functions are implemented with processors organically combined, while each of the processors performs a specific facility in the independent environment.

The optical loop bus permits the connection of up to 62 processors, allowing a free and flexible system configuration to meet the user's needs.

The NCOM200 system is characterized by its flexibility and expandability as described below.

(i) Flexibility of the system configuration

The NCOM200 system offers the optimum system configuration suitable for the organization of a telephone operating company, the scale of networks, and the network equipment. The NCOM200 system in addition to the above, has the following features that facilitate its adaptation to the standardization:

a) The hardware and software modularization employed for the system, in addition to a completely distributed processing architecture, will permit the construction of a variety of the system configurations; from the one with a smaller capacity having a few functions to the one with a larger capacity having many functions. Thus, the optimum system configuration can be constructed according to the user's requirements.

b) Intensified data exchanging function and retrieval function enable each of operation, maintenance, or administration centers to retrieve only required data, and permit the free allocation of a usable function to each terminal. This, in turn, enables a telephone company to construct a system configuration which is most suitable for the company organization.

c) The separation of line control processors permits the processing of differences in protocol for equipment to be managed within relevant processors,allowing various equipment to be connected, thus configuring an architecture which provides an easier access to the forthcoming standardization.

(ii) Expandability of the system

An expansion of the network will involve an increase in types and numbers of equipment to be managed and subsequently the organization of a telephone operating company will be changed. Furthermore, advanced technologies and the standardization development will accelerate the obsolescence of the the system.

To cope with these changes, the following facilities are provided for the system to maintain the optimum conditions by expanding the system capacity and functions:

a) The system is hierarchically configured to permit the connection for up to 62 processors to a 32 Mbps optical loop bus, with slave processors connected to the preceding processors for the line control. Thus, the system can be expanded for a required portion to a required extent.

b) With the line control processors, the connection to the EWS and the main-frame computer system can be accomplished with less difficulty, thus allowing the enhancement of data processing, the creation of data base, and the connection to the OS that is defined in the TMN standards.
Because the applications are written in the C language, they are superior in portability, and facilitate an expansion of the system functions.

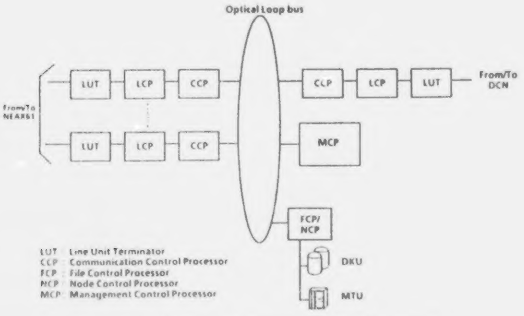
Optical Loop bus
From/To NEAX61
LUT
LCP
CCP
CCP
LCP
LUT
From/To DCN
MCP
FCP/ NCP
DKU
MTU
LUT : Line Unit Terminator
CCP : Communication Control Processor
FCP : File Control Processor
NCP : Node Control Processor
MCP : Management Control Processor

FIGURE 6 NCOM200 DISTRIBUTED PROCESSOR ARCHITECUTURE

(2) NCOM1000

NCOM1000 is a software package that can be operated on the platform shown in Figure 7, and has the following features:

(i) Operating system

An operating system, AT&T UNIX System V, is used for this environment. The NCOM1000 is compatible with this environment and is operable on any hardware platform having both the preceding operating system and the ORACLE RDBMS.

The UNIX System V operating system provides the highest possible portability that extends to all the hardware platforms conceivable.
In fact, any CPU supporting UNIX System V operating system can be used with a super-micro computer, minicomputer, mainframe, and a newly emerging parallel processor. Thus, NEC can be responsive to any customer request for a specific hardware having a capability and an appropriate size to the customer's needs.
With the ceaseless advance in the processor capability, the obsolescence of of the system due to outdated hardware is diminishing.
The NCOS1000 has a bridging capability toward increasingly powerful processors along with the advance in customer's processing capability.

The NCOM1000 provides and excellent portability, so that the software investment by a telephone operating company can be made most efficient and effective. The investment for this system will be all the more justified when potential needs for larger processors become realistic.

This is especially important, since the industry survey indicates that the average life of hardware systems is two to four years, while that of application systems is nearly ten years. Incidentally, software costs continue to increase while hardware costs continue to decrease on a price performance basis.

(ii) Data base manager

The NCOM1000 utilizes the ORACLE Relational Data Base Management System (RDBMS).

(iii) Programming language

All applications in the NCOM1000 are written in the C language. These applications include embedded "calls" to the ORACLE RDBMS using the ORACLE PRO C interface.

This highly efficient and optimized language facilitates the development and maintenance of system programs. Resulting programs are more easily coded, tested, and maintained with increased reliability.

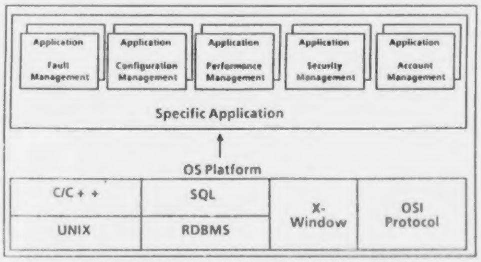
Application Fault Management
Application Configuration Management
Application Performance Management
Application Security Management
Application Account Management
Specific Application
OS Platform
C/C + +
SQL
UNIX
RDBMS
X-Window
OSI Protocol

FIGURE 7 OPERATIONS SYSTEM ARCHITECTURE

3.4 Features of NCOM200/1000

(1) NCOM200/1000

The NCOM200 can be regarded as a sub-network management system and NCOM1000 as a consolidated management system for NEC's NEAX61 central office switching system, thus implementing the centralized maintenance of NEAX61 with NCOM200/1000. The NCOM200 and NCOM1000 feature an advantage of being classifiable in terms of their functions according to the concept of a functional center. In the functional performance, it is possible for the functional center to be defined in functional terms of operation, maintenance, and administration.
Typical functional centers are as follows:

- Operation and Maintenance Center (OMC)
- Line Test and Service Center (LTSC)
- Billing Center(BC)

Each functional center provides a single or a plurality of functions, namely, operation, maintenance, and administration.
The operation and maintenance functions are required for keeping up switching system and network functions and capabilities at high-quality levels.
The administration function assists telephone operating company personnel in the work associated with the system or network expansion, improvement in the grade of services, an increase in profit, and so forth.

Figure 8 shows an example of NCOM job assignment. The functional assignment of NCOM200/1000 can be changed according to the operational mode of a telephone operating company.

JOB		NCOM200	NCOM1000
Operation & Maintenance	Network Surveillance (Alarm Traffic Status)	◎	○
	Network Maintenance (Test Repair)	◎	○
	Network Management (Traffic control Routing control)	○	○
Administration	Service order Processing		◎
	Customer Complaint Management		◎
Charging	Charge Data Collection	◎	
	Accounting and Billing		◎
Resource Management	Facilities Management		◎
	Workforce Management		◎
Network Planning	Network Analysis		◎
	Network Planning		◎

FIGURE 8 EXAMPLE OF NCOM JOB ASSINGMENT

3.5 NCOM Application Configuration

The NCOM system consists of the following four parts:

- Data Communication and Control Part
  The data communication and control part is a kind of data exchanging function in which various data transferred from network elements are edited into a common form suitable for the NCOM internal processing, or these data are controlled and supplied to the NCOM application. This part also supports the OSI protocol stacks. Candidate Q3 protocol stack of the NCOM is shown in Figure 9.

- NCOM Application Part
  The NCOM application part realizes the management function. The following is some management functions by the NCOM application part, which conforms to the CCITT TMN applications functions.

  a) Performance management
  b) Fault management
  c) Configuration management
  d) Accounting management
  e) Security management

To accomplish these functions effectively, a Graphic User Interface (GUI) is used for visible and flexible network surveillance, as well as Advanced Event processing for effective network elements control.

(1) GUI
The user can define network element attributes such as the type of switching system, the shape of symbol, color, location, and so on.

(2) Advanced Event processing
The user can define a necessary control triggered by user definable event such as message number, alarm type, alarm frequency, and forth.

- Data base management part
  All application data in this system are under the control of relational data base management system (RDBMS). The RDBMS provides a full support to the Structured Query Language (SQL) as its built-in query facility.
  The SQL is the industry standard development for the purpose of retrieving information from relational data base.
  The RDMBS provides a host-language interface to the C language.

This enables complex program processes to be developed that access the system data base in a consistent manner.

- Human-Computer Interaction Control Part
  Most of the operation and maintenance services are performed via operation terminals. The human-computer interaction provided at the terminal has a direct impact on the service efficiency. This part provides a sophisticated human-computer interaction for effective operations.

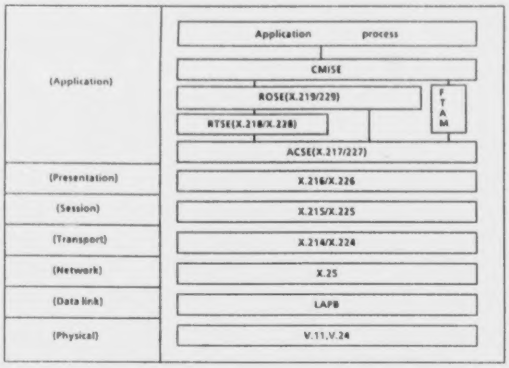

FIGURE 9 NCOM CANDIDATE Q3 PROTOCOL STACK

4. Conclusion

This paper has discussed the standardization of a consolidated network management system and an approach to the standardization with the NCOM.

The focus points of the discussion are firstly that the existing product line of the NCOM will provide solutions to the current network management problems to a considerable extent and, secondly, that the NCOM will provide a means of coping with the future standardization with its flexible architecture.

It is anticipated, however, that the establishment of a true multivendor environment including the implementation of the standardization will require quite a length of time.

Undoubtedly, the NCOM system will provide total network solutions for the current and future communications networks using sophisticated Computers & Communications (C & C) technologies.

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[REFERENCE]

CCITT Recommendation M.30 "Principles for a Telecommunications Management Network (TMN)"

CCITT Recommendation Q.513 "Exchange Interface for Operation, Administration and Maintenance"

CCITT Recommendation G.711 "Q-Interfaces and Associated Protocols for Transmission Equipment in the Telecommunications Management Network (TMN)"

K.Sumal, H. Altenhofen and T. Kashima (1990). "An Object Oriented Design for a Distributed INM System" Proceedings of NEC second software conference in USA. 8-18

T. Yoshizawa and N. Kadoyashiki (1989) " NEC's Computerized Operation and Maintenance System(NCOM)" NEAX61 Digital Central Office Switching System. 86-91

A TDX Internal Protocol Modeling by Utilizing Extended Timed Petri nets

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1. ABSTRACT

This paper deals with the modeling of the TDX-10 Internal Protocol(TIP). The TIP has been designed for providing packet-mode services among the TDX-10 switching systems. Before the TIP is implemented, it must be validated. In order to do this, we first extend timed Petri nets with time-out mechanism and then model the TIP using the extended timed Petri nets.

2. INTRODUCTION

An internal protocol has been designed for providing packet-mode services among the TDX-10 switching systems, being developed as an ISDN exchange in Korea, residing within a single network. It is called the TIP (TDX-10 Internal Protocol). The TIP has the internal call states and their transitions according to events, timers, and counters[3].

Before the TIP is implemented, it is necessary to do protocol validation to check design errors such as deadlock, unspecified reception, state ambiguity, etc. For protocol validation we need to model the TIP using formal modeling methods.

Among various modeling methods, timed Petri nets is one of the promising ways in the sense that it can represent asynchronous and concurrent activities with specified execution times by single basic mechanism. In applying timed Petri nets, however, it is often necessary to add special modifications or restrictions suited to the particular application.

In order to model the TIP using timed Petri nets, timed Petri nets should be extended. Although timed Petri nets have their own time-out mechanisms, these are not enough to describe the activities of the TIP correctly. In this paper, we propose an Extended Timed Petri net (ETPN) to describe timers and counters, and model the TIP using it.

The subsequent section briefly describes the application and function of the TIP. In section 3, an ETPN is proposed and how the ETPN can be used to model the TIP is described. In section 4, some properties of protocol validation such as correctness, liveness, and so on, are presented. Finally, section 5 contains the conclusion of this paper.

3. TDX-10 INTERNAL PROTOCOL

3.1 TIP Application

The functional elements of the network to which the TIP can apply are DTE, DCE, the TDX-10 Internal Packet Handler(TIPH), Signaling Terminating equipment(STE), and Network Operation and Management Center(NOMC). Figure.1 shows their relationships in the applicable network environment of the TIP.

3.2 Functional overview of TIP

The TIP has two purposes; The first one is to transfer X.25 packets transparently and the second one is to support the communication between NOMC and TDX-10 PH's. In order to satisfy these purposes we define internal packet messages which are grouped by call setup and clearing internal packets, data and interrupt internal packets, flow and error control internal packets, reconnect internal packets, and network facility internal packets.

The TIP has several procedures such as VC(virtual call) setup, data and interrupt transfer, reconnect and reset, and clear procedure to provide virtual call services.
To clarify these procedures we describe the mission of an originating switch, a tandem and a destination switch.

An originating switch is responsible for controlling the VC setup procedure and reconnect procedure. The originating switch starts the internal VC setup procedure when a call request X.25 packet from an originating subscriber is arrived. Then the switch translates the X.25 packet to the corresponding internal packet and plays a role as the data sender with flow control and error control.

The tandem switch selects the shortest route to the next switch for reaching to the destination switch, chooses the logical channel number on that route , and sends the setup internal packet which is changed to a new logical channel number. If the tandem switch detects the virtual connection fails, the tandem switch requests the originating switch to reconnect the virtual path.

In the destination switch the VC setup internal packet is translated to the incoming call X.25 packet and the correct response from the destination subscriber can make the destination switch send the VC setup accept internal packet. In the data transfer phase that follows the VC setup procedure, the destination switch carries out the flow control by sending RR or RNR internal packet and provides the error-free data transmission by sending the retransmit internal packet as an indicator of the starting pointer [3][4].

4. TIP MODELING

4.1 Conventional Petri nets

Petri nets are a formal graph model for modeling the flow of information and control in systems. A Petri net consists of P(a set of places - circles), T(a set of transitions - bars), I(input function), , O(output function), and μ(marking function). P and T are finite sets and I and O are mapping functions from T to P. μ assigns to each place P a pattern of tokens which is a nonnegative integer[5][6].

A Petri net is defined as follows[6]:

$$PN = \{P,T,I,O,\mu\}$$

$P = \{P1,P2, .. Pn\}$ is a finite set of places
$T = \{T1,T2, .. Tn\}$ is a finite set of transitions
$I : t_j \epsilon T \rightarrow I(t_j) \epsilon P$ is the input function of transition
$O : t_j \epsilon T \rightarrow O(t_j) \epsilon P$ is the output function of transitior
$\mu : P \rightarrow N$ is the marking function
where N is positive integer and $P \Lambda T = \emptyset$

4.2 timed Petri nets

In order to model communication protocols, Petri nets are extended to include the notion of time[4][7]. In such extended nets, called timed Petri nets, each transition is associated with enabling time and firing time. These two times give some measures of minimal and maximal execution times of the transitions [2].

A timed Petri net can be defined as follows:

$$TPN = \{P,T,I,O,\mu,E,F\}$$

$P = \{P1,P2, .. Pn\}$ is a finite set of places
$T = \{T1,T2, .. Tn\}$ is a finite set of transitions
$I : t_j \epsilon T \rightarrow I(t_j) \epsilon P$ is the input function of transition
$O : t_j \epsilon T \rightarrow O(t_j) \epsilon P$ is the output function of transition
$\mu : P \rightarrow N$ is the marking function
$E : t_j \epsilon T \rightarrow R$ is the enabling time function of transition
$F : t_j \epsilon T \rightarrow R$ is the firing time function of transition
where N is positive integer, R is real number ,
and $P \Lambda T = \emptyset$

4.3 An extension of timed Petri nets

In timed Petri nets described above, a firing time of transition is usually represented by $[T_{min},T_{max}]$ where T_{min} and T_{max} represent minimum and maximum time respectively [2].

However, it is not enough to describe the time-out mechanism of the TIP correctly because the TIP has timer and counter functions. So an extension is proposed by introducing timers and counters to timed Petri nets. For instance, if a required ack-message doesn't respond within T_{min} after sending a packet message, the packet message retransmits and waits for T_{min} and this process is repeated R times. In this case, the time threshold is T_{min} x R and the firing time is simply represented by $[T_{min}]$ instead of $[T_{min},T_{max}]$. Then the counter can be represented by the place associated with R.

A protocol model by extended timed Petri nets(ETPN) can be considered to be made up of timer, counter and reset. If the wanted packet message is arrived within R, the counter is reset and the transition is fired to the next normal state.

An extension of the timed Petri nets(ETPN) is defined as follows:

$$ETPN = \{P,T,I,O,\mu,L_t,L_c\}$$

$P = \{P1,P2, .. Pn\}$ is a finite set of places
$T = \{T1,T2, .. Tn\}$ is a finite set of transitions
$I : t_j \epsilon T \rightarrow I(t_j) \epsilon P$ is the input function of transition
$O : t_j \epsilon T \rightarrow O(t_j) \epsilon P$ is the output function of transition
$\mu : P \rightarrow N$ is the marking function
$L_t : t_j \epsilon T \rightarrow L_t(t_j) = T_f$ is the label condition function of transition for timer
$L_c : t_j \epsilon T \rightarrow L_c(t_j) = R$ is the label condition function of transition for counter

where T_f is a timer value ϵ real number, R is a limit value of counter ϵ N(positive integer), and $P \Lambda T = \emptyset$.

Note 1 : To distinguish between state node and packet node, the two place symbols of different shapes are used.
Note 2 : We simply represent T_f instead of T_{min} in case of $T_{min} = T_{max}$.
Note 3 : In case of not representing a level in transition bar, the T_f and R can be regarded as 0.

With this extended timed Petri net model, the complex protocol like the TIP can be modeled. Figure 2 shows this ETPN ,focusing timer and counter. In Figure 2, the tokens placed in the counter are incremented by one whenever the time T_f passes. When the number of incremented tokens are exceeded the transition condition R, the transition with both l-arc and r-arc is fired to the abnormal state. The l-arc handles the last token placed in the original state and the r-arc represents the multiple arcs of which number are equal to the limit value R.

4.4 TIP modeling

The TIP has several procedures in order to perform packet transfer functions such as virtual call set up, virtual call clear, data transfer, reset and reconnect procedure and has also routing function in order to provide network management facility between TDX-10 system and network management center.

Since the TIP may handle the protocol between external interface and calling side packet handler, between calling and called side packet handler (TIPH),and between called side and external interface, the interactive primitives between communication processes such as call request, clear request and call accept are needed. To describe these primitives and represent each resource well, an ETPN model is used as follows:

The number 0, 1, 2, and 3 represents an external interface of calling side(X.25), a location of the calling side TIPH, a location of the called side TIPH and an external interface of the called side(X.25) , respectively. Each state of the calling side TIPH and the called side TIPH is represented by each place of 1 and 2. The interactive primitives(packets) between the external interface and the TIPH are represented by tokens in 0 and 3. The packets between TIPHs are represented by tokens between 1 and 2.

The ETPN models for the VC setup and the VC clear procedures are shown in Figure 3 and 4, respectively. To distinguish between state node and packet node, the two place symbols, rectangular(state) and circle(packet), are used in these figures. To simplify packet node associated with the data, double circles are used and the 'DATA' includes data, receive ready, receive not ready, interrupt, interrupt confirm packets.

5. TIP VALIDATION

The protocols can be proved with respect to the specific properties as follows:

1) correctness

A protocol should have the ability which returns to the original state under any condition. The TIP has interactive primitives of clear and reset phase for correctness such as clear request, clear confirmation, clear indication, reset request, reset confirmation, and reset indication. This property can be validated naturally during the design phase.

2) state ambiguity

During making an ETPN model, state ambiguities can be detected. In the VC setup phase, for instance, a state V1 (ready), on receipt of a VC_setup_req packet, sends a X.25 IC(Incoming Call) packet to the external interface. And then the state V1 should be transferred to the state V2 (call request) and the state V2, in turn, waits for a X.25 CA(Call Accept) packet. But, if the state V2 doesn't exist and the state V1 receives a X.25 CA packet instead of V2, then this causes the state ambiguity.

The state ambiguity can be detected in the ETPN model , as shown in Figure 5.1. This transition should be changed as shown in Figure 5.2.

3) livelock

Liveness means a protocol finally enters into a satisfiable state. That is , it can be reachable to any state or original state from each reachable state. To prove livelock freeness property, the protocol should have a cycle of the states and must not repeat the cycle in a same path. This cycle which has several pathes can be shown by making a reachability graph. The reachability graph cab be drawn from the ETPN model[7].

4) boundedness

Protocol behavior is bounded when no overflow can occur or it has a finite number of states[8][9]. The boundedness in a Petri nets says that the number of tokens at each place is limited. As mentioned in the ETPN model of the TIP , the timer handling mechanism with the timer T_f and the counter R in the ETPN model may prevent that the number of tokens is incremented infinitively.

Besides the properties mentioned above, the other validation properties such as recovery, deadlock, unspecified reception, reachability and fully livelock freeness are presented in [7].

6. CONCLUSION

This paper described a protocol modeling for an internal protocol for packet-mode services between the TDX-10 switching systems, which is called the TDX-10 Internal Protocol(TIP) by using the Petri nets. The conventional Petri nets and timed Petri nets were introduced. By extending the timed Petri nets, an ETPN model could handle the timer mechanism which is a necessary part of complex protocols. Some properties of protocol validation were presented.

For the future work, the modeling for performance evaluation of the TIP, for instance, an extension of stochastic Petri nets, will be considered.

REFERENCE

[1] T.Murata, "Modeling and Analysis of Concurrent Systems," Handbook of Software Engineering, ed. by C.R. Vick and C.R. Ramamoorthy, NewYork: Van Norstrand Reinhold, 1983, pp. 39-63
[2] P.M. Merlin, "Recoverability of Communication Protocols: Implication of Theoretical Study", IEEE Trans. on Communications, Vl. COM-24, No.9, pp. 1036-1043, Sep. 1976
[3] Kyung-pyo Jun, "An Internal Protocol for Packet-Mode Services in ISDN", Asian ISDN Council, 1990
[4] S.S Joo "General requirement of TDX Internal Protocol" ETRI TM, Jul. 1989
[5] James L. Peterson, "Petri Net Theory and the Modeling of Systems", Prentice-Hall, pp. 79-150, 1981
[6] Tadao Murata, "Petri Nets: Properties,Analysis and Applications" Proceedings of the IEEE, Vol.77, No. 4, April 1989
[7] C.W. Ro "TDX Internal Protocol Validation" ETRI TM, Jan. 1990
[8] D.K. Seong "The Protocol Design Techniques" ETRI TM, Jun. 1989
[9] J.M. Ayache, "Specification and Verification of Signaling Protocol" International Switching Symposium, CIC Montreal,May 1979

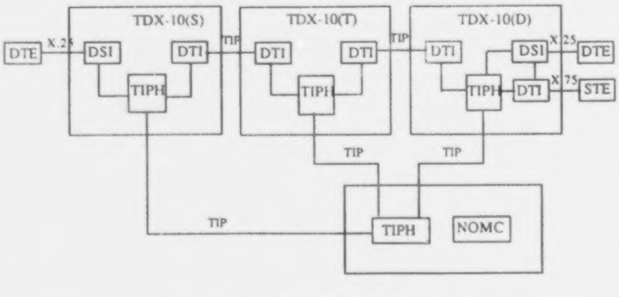

Figure 1. Relationship of TIP and functional elements

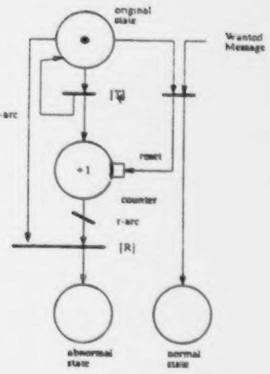
original state
Wanted Message
[T]
l-arc
+1
reset
counter
r-arc
[R]
abnormal state
normal state

Figure 2 An Extension of Timed Petri Nets

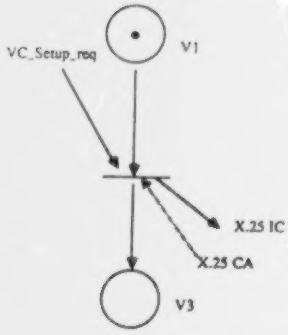
VC_Setup_req
V1
X.25 IC
X.25 CA
V3

Figure 5.1 state ambiguity

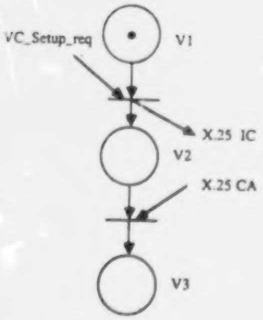
VC_Setup_req
V1
X.25 IC
V2
X.25 CA
V3

Figure 5.2 normal state

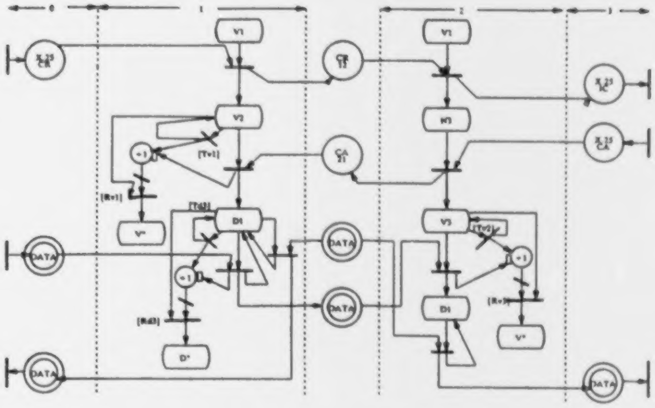
0
1
2
3
V1
X.25 CR
CR I1
X.25 IC
V2
CA I1
X.25 CA
[Tv1]
[Rv1]
V*
[Td1]
D1
DATA
[Rd1]
D*
V3
[Tv2]
[Rv2]
V*

Figure 3 VC setup procedure - Extended Timed Petri Nets Model

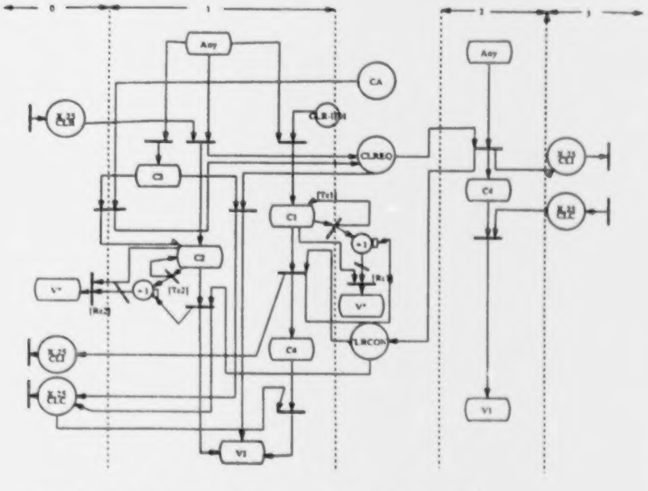
0
1
2
3
Any
CA
X.25 CLR
CLR-IDU
CLREQ
C3
C1
[Tc1]
C2
V*
[Rc2]
[Tc2]
[Rc1]
X.25 CLI
X.25 CLC
C4
CLRCON
V1

Figure 4 VC clear procedure - Extended Timed Petri Nets Model

An Architecture For Circuit Provisioning Systems

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Abstract

An architecture for designing interoffice provisioning systems has been developed. This architecture includes a hierarchical functional model, and a description of standard interfaces between sub-systems. It is suitable for interoffice circuit provisioning activity, and requires approximately three to twelve months to be completed.

1. Introduction

Network management systems contain several functions that common carriers can use to significantly enhance the efficiency of their operations. This includes circuit provisioning, performance testing, fault localization and traffic control. The circuit provisioning function sets up circuits from network facilities, and is able to meet service requests from customers at anytime. The circuit provisioning function assures that a sufficient amount of circuits are provided in-time by a minimum amount of facilities. This function is therefore, one of the most important functions in the network management business.

Currently, many processes for circuit provisioning are carried out manually, with human-to-human interactions between several offices. To facilitate introduction of an automated system, these processes are divided into small sub-systems. These sub-systems interact, resulting in an integrated circuit provisioning process.

This paper describes the concepts underlying the configuration of circuit provisioning systems, and discusses the hierarchical functional model and interfaces which should be standardized. Finally, it introduces details of the implementation of NTT's interoffice circuit provisioning system.

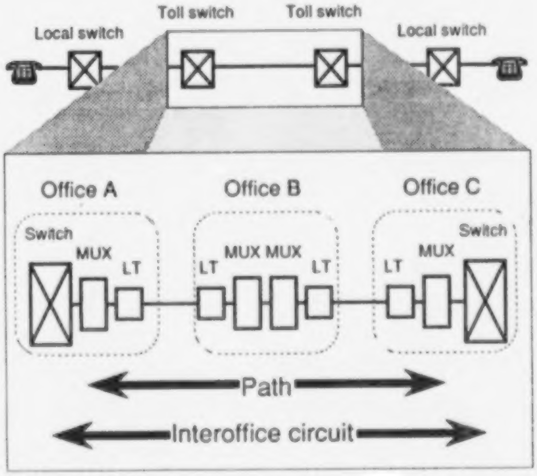
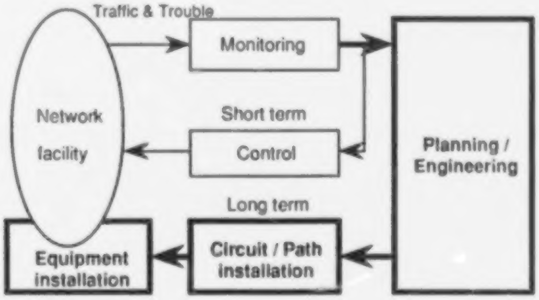


Figure 1
Structure of interoffice circuit and path

2. Interoffice Circuit and the Provisioning Process

An interoffice circuit consists of two switches which terminate the circuit on each end, and a path which ties together the two switches. The path contains MUXs and LTs, and provides a semi-permanent transmission path between two points. The interoffice circuit provisioning system can efficiently set up the interoffice circuit and path. Figure 1 shows a typical structure of an interoffice circuit.

Two kinds of network management activities are outlined in Figure 2. These activities prevent degradation of service resulting from monitored traffic anomalies and other troubles. One activity is traffic control using the call processing function of switching systems. The other is interoffice circuit provisioning, which is discussed in this paper.
Traffic control can be applied to congested or damaged networks, instantaneously, by means of a routing algorithm of call processing, instead of changing the network configuration (i.e., it creates / deletes circuits, changes circuit destinations, etc.). Interoffice circuit provisioning changes the network configuration efficiently, to prepare for future customer demand.



Note: Arrows and boxes drawn by thick lines represent circuit provisioning activity.

Figure 2 Network management activities

Dynamic provisioning , one of the advanced technologies used in provisioning, has very short lead time. The architecture discussed in this paper is primarily applied to non-dynamic provisioning, or planned provisioning (hereafter called 'provisioning').

There are many processes involved in dynamic and non-dynamic provisioning. Figure 3 shows the generic process flow of interoffice circuit provisioning activity. It is a multi-step process, but two major parts can be identified. One is Planning / Engineering and the other is Installation.
The entire flow of the process of interoffice circuit provisioning activity is integrated by the system based on the architecture.

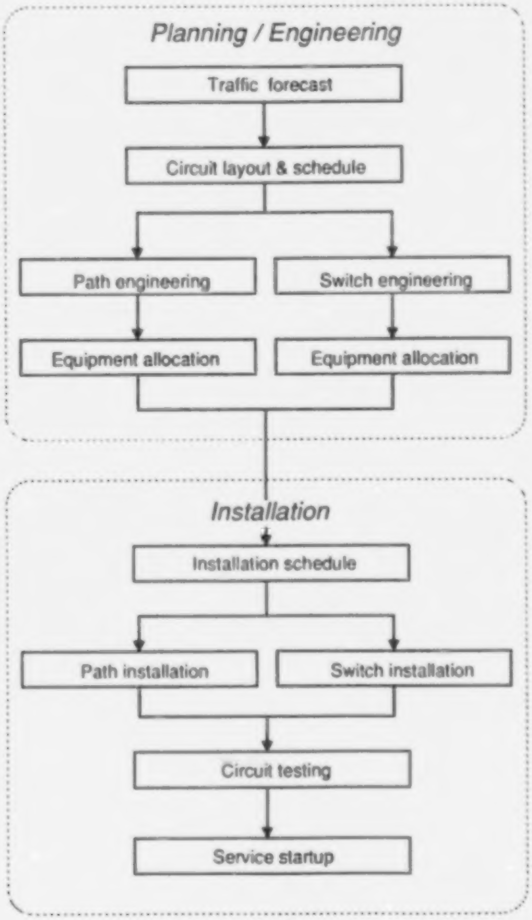


Figure 3
Process flow for interoffice circuit provisioning

3. Conceptual Framework

3.1 General considerations

There are three general issues to be considered in interoffice circuit provisioning systems. The following provides a detailed description of each issue.

3.1.1 Interoperability among sub-systems

Interoperability among many sub-systems should be guaranteed even though these sub-systems may have different hardware, operating systems and internal data structures. This can be achieved by adopting standard interfaces among sub-systems.

3.1.2 Independent evolution of sub-systems

Allowances should be made for functional enhancement or migration of future sub-systems developed by state-of-the-art engineering technology, or for new communication equipment. This could be achieved by designing sub-systems under a unified architecture.

3.1.3 Accurate updating of information stored for network management

All changes to the interoffice network configuration can be carried out using the interoffice circuit provisioning system. Therefore, information storage for network management (i.e., network configuration and facility inventory) will be more accurately updated than is the case when sub-systems are operated independently and separately. High information storage accuracy can then be achieved.

3.2 Special considerations pertaining to interoffice circuit provisioning

There are four issues pertaining to interoffice circuit provisioning system. The following provides a detailed description of each issue.

3.2.1 Support of interoffice activities

Cooperation between offices is indispensable to successfully providing interoffice circuits. This is because these circuits are installed between two switching offices, and there may be transmission relay offices between the two switching offices as well. It is also possible that each office will belong to a different common carrier, i.e., long line carriers, local exchange carriers, etc. Coordination between switching offices and transmission relay offices is thus one of the most important parts of interoffice circuit provisioning.

3.2.2 Installation schedule changes

The installation schedule of interoffice circuits is subject to change for many reasons; e.g., late equipment arrival, or any delay in outside plant construction. Therefore, a flexible rescheduling capability should be supported.

3.2.3 Coexistence and cooperation between human and machine

Installation of network facilities and/or equipment for interoffice circuit provisioning has a wide variety of technical levels. SPC machines, like digital switching systems or digital crossconnects, support remote operation for reconfiguration. Cross-bar switching systems and conventional transmission equipment require on-site operation by work forces for reconfiguration. For example, distribution frames definitely require hand wiring. Thus, the architecture should be flexible enough to be applied to those operation targets that require human intervention, without forcing unnecessary changes.

3.2.4 Adapting to distributed systems environments

Operation systems for such technical fields as circuit and equipment design and maintenance, are typically developed and introduced independently. These systems adopt different hardware, operating systems and application programs to meet specific requirements. Therefore, the interoffice circuit provisioning system should use these systems as sub-systems to avoid redundant development investment.

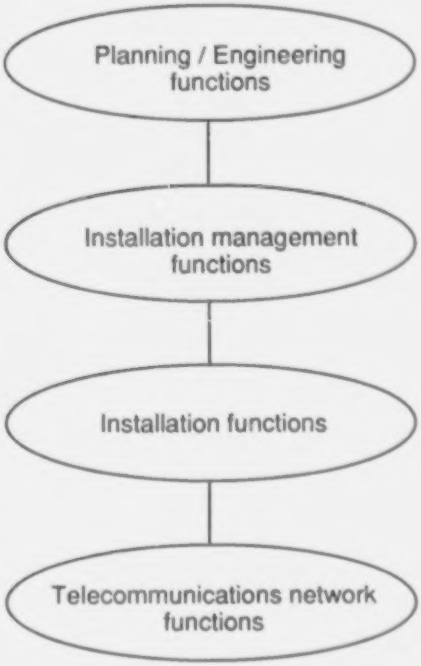

Planning / Engineering functions
Installation management functions
Installation functions
Telecommunications network functions

Figure 4 Hierarchical functional structure for interoffice circuit provisioning

4. Proposed Architecture

The proposed interoffice circuit provisioning system is a distributed system complex consisting of several sub-systems of many types. To guarantee integration, flexibility, ease of enhancement and maintenance in these circumstances, the system must be developed and deployed based on unified architecture.

4.1 Functional Model

4.1.1 Hierarchical functional structure

As described in sections 2 and 3.2, interoffice circuit provisioning requires both installation management and installation work. This can involve many offices, and include testing of circuits and paths in addition to installation of transmission and switching equipment. These activities commonly include a rescheduling function which adjusts the installation schedule to coordinate and maintain the progress of works in many offices and sections.

Therefore, the installation management function, which has a rescheduling function, should be considered for inclusion in the interoffice circuit provisioning system. Figure 4 shows a proposed functional structure of interoffice circuit provisioning. It has various function layers, such as planning / engineering , installation management, installation, and telecommunications networks.

4.1.2 Detailed functions of each layer

Figure 5 shows detailed functions of each layer for interoffice circuit provisioning. Installation orders and result reports are handled as "tickets" by the ticket manager function in the installation management layer. The following is a brief explanation of a successful process flow conducted by a ticket manager to set up an interoffice circuit.

1) The ticket manager receives information regarding installation orders and tight schedules for interoffice circuit provisioning from the planning / engineering layer.
2) The ticket manager has the scheduler and work force manager establish a detailed schedule for installation.
3) According to the detailed schedule, the ticket manager issues installation tickets to each ticket handler in the installation layer.
4) Ticket handlers supervise the actual installation of equipment in each office.
5) Command input is executed automatically to sophisticated switching systems or transmission systems, according to the ticket information.
6) The work force receives instruction for wiring distribution frames or for other kinds of operations from the human - machine interface, and executes accordingly.
7) Finally, ticket handlers report the circuit installation and testing results to the ticket manager in the installation management layer.

More detailed functional descriptions and management information to be handled in functional elements are listed in Table 1.

4.2 Design of interface between sub-systems

Each carrier is responsible for making functional assignments to the actual sub-systems. This should be done considering economy, system performance, use of existing operations systems and ease of functional enhancement. However, standard interfaces between sub-systems have to be defined to guarantee the requirements described in section 4. There are three proposed interfaces to define. These interfaces correspond to the layer boundaries between the four layers shown in Figure 4. The following provides detailed descriptions for each interface.

4.2.1 Between planning / engineering and installation management

This interface provides a standard means for sending and receiving circuit configuration information, equipment configuration information, growth plan and installation orders between the Planning / Engineering layer and the Installation management layer.

The communications protocol should conform to the Q3 interface protocol(1)(2) defined in the standardization activity of the Telecommunication Management Network (TMN) (3) in CCITT. Q3 interface protocol is designed to be applied to the interface between operations systems and network elements. Q3 interface protocol conforms to Open Systems Interconnection (OSI) (4) which has been standardized in ISO and CCITT.

4.2.2 Between installation management and installation

This interface provides a standard means for sending and receiving ticket information between the installation management layer and the installation layer. Communications protocol should conform to the Q3 interface protocol.

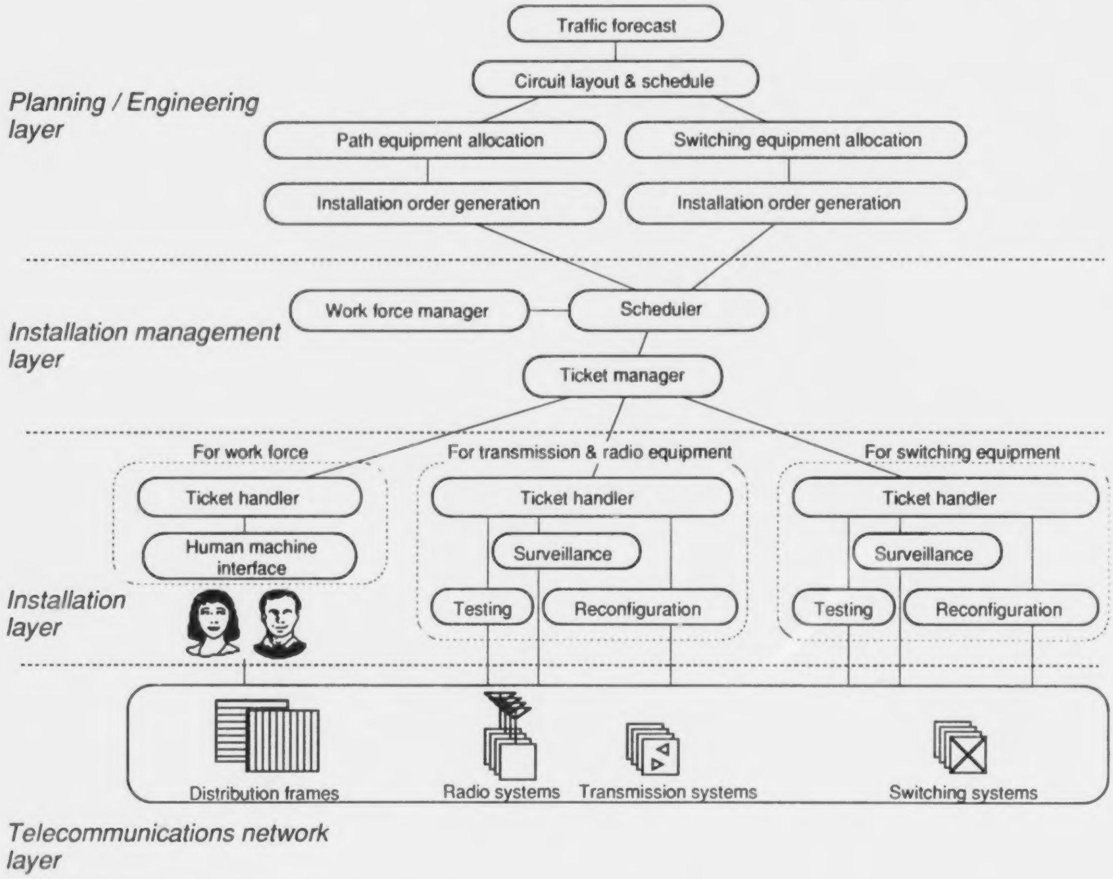

Traffic forecast
Circuit layout & schedule
Planning / Engineering layer
Path equipment allocation
Switching equipment allocation
Installation order generation
Installation order generation
Work force manager
Scheduler
Installation management layer
Ticket manager
For work force
For transmission & radio equipment
For switching equipment
Ticket handler
Human machine interface
Ticket handler
Surveillance
Testing
Reconfiguration
Ticket handler
Surveillance
Testing
Reconfiguration
Installation layer
Distribution frames
Radio systems
Transmission systems
Switching systems
Telecommunications network layer

Figure 5 Functional model for interoffice circuit provisioning

Table 1 Functional element and management information

Functional layer	Functional element	Management information
Planning / Engineering layer	Traffic forecast - estimate future traffic and path usage	Path usage Traffic Circuit configuration Equipment configuration Growth plan Installation orders
	Circuit layout & schedule - design circuit configuration - determine time and scale of circuit growth	
	Path / switching equipment allocation - allocate equipment for configurating circuit	
	Installation order generation - generate commands and instructions for configurating circuit	
Installation management layer	Scheduler - establish and modify detailed installation plan - harmonize installation plans among different offices	Skill and availability of work force Scheduling rules Calender / Time table Status of issued installation ticket
	Work force manager - provide information regarding skills and availability of work force	
	Ticket manager - issue, track and delete installation tickets	
Installation layer	Ticket handler - accept, interpret and send back tickets - report status of specific ticket	Received installation ticket status Alarm status Installation status Testing status
	Human machine interface - present work items to work force, and receive work reports	
	Surveillance - monitor alarms from telecommunications network equipment	
	Testing - test telecommunications network functions	
	Reconfiguration - conduct installation activities for network reconfiguration	
Telecommunications network layer	Switching Transmission Line..	———

4.2.3 Between installation and telecommunications network

This interface provides a standard means for sending and receiving commands and status information of network equipment between the installation layer and the telecommunications network layer.
Communications protocol should conform to the Q3 interface protocol. However, non-standard management interfaces should also be adopted for this interface to allow for the migration of existing network equipment.

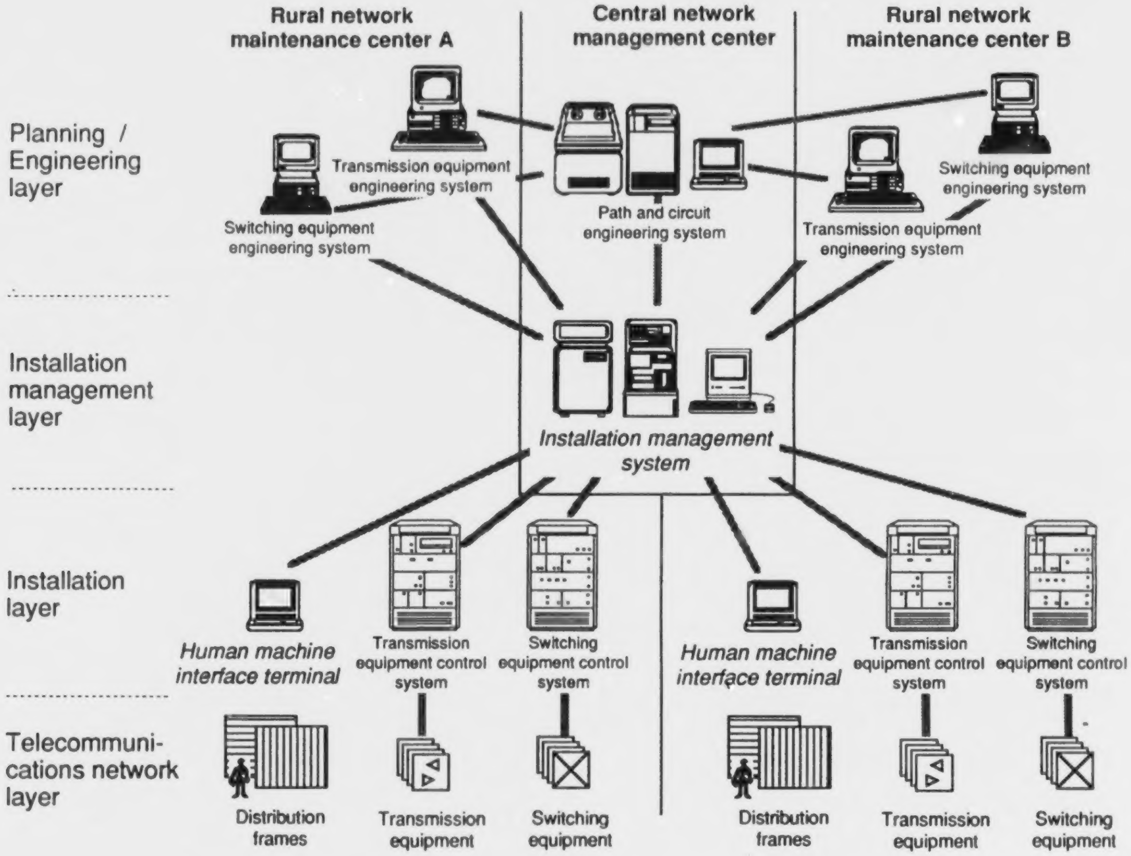
5. NTT's Interoffice Provisioning System

NTT has already deployed a number of operation systems (5)(6) with functions that correspond to the planning / engineering layer and the installation layer, and they automated certain operations in these layers.
However, many operations must still be executed by the work force. Most of the work is carried out using current management tools and the telephone. This includes command inputs for reconfiguration and testing of SPC switching systems or transmission equipment, circuit card insertion to equipment, wiring of distribution frames and making schedules.

Figure 6 shows the configuration of NTT's interoffice provisioning system as an example of implementation strategy under present circumstances. This system consists of planning / engineering sub-systems, the installation management system and some installation systems.

The Path and circuit engineering system delivers rough provisioning schedules to the installation management system. The switching equipment engineering system and the transmission equipment engineering system send installation orders for equipment to the Installation management system. The installation management system is centralized, following a decision based on an estimation of communication traffic and required throughput.

This system can successfully provide both paths and circuits, while cooperating with existing operation systems in NTT's network.


Rural network maintenance center A
Central network management center
Rural network maintenance center B
Planning / Engineering layer
Transmission equipment engineering system
Switching equipment engineering system
Path and circuit engineering system
Switching equipment engineering system
Transmission equipment engineering system
Installation management layer
Installation management system
Installation layer
Human machine interface terminal
Transmission equipment control system
Switching equipment control system
Human machine interface terminal
Transmission equipment control system
Switching equipment control system
Telecommunications network layer
Distribution frames
Transmission equipment
Switching equipment
Distribution frames
Transmission equipment
Switching equipment

NOTE : Sub-systems with *italic* captions are newly developed for this system.

Figure 6 System configuration for NTT's Interoffice Provisioning System

6. Conclusion

We have proposed an architecture for designing interoffice provisioning systems. The architecture includes a hierarchical functional model, and a description of standard interfaces between sub-systems.

This architecture is suitable for interoffice circuit provisioning activity and requires three to twelve months to be completed. The same architecture could also be applicable for dynamic provisioning of interoffice circuits by reserving a number of interoffice circuits for this purpose.

Acknowledgements

The authors would like to thank Mr. M. Ejiri for suggesting the approach of this research and encouraging the writing of this paper. We would also like to express our appreciation to Mr. M. Kachi and Mr. S. Sasuga for their advice and guidance concerning provisioning tasks.

References

(1) CCITT Draft Recommendation Q.961 "Lower layer protocol profile for the Q3 interface," 1990
(2) CCITT Draft Recommendation Q.962 "Upper layer protocol profile for the Q3 interface," 1990
(3) CCITT Recommendation M.30 "Principles for a Telecommunications Management Network," 1988
(4) ISO International Standard 7498 "Open Systems Interconnection - Basic Reference Model," 1983, etc.
(5) Fumihiko DEGUCHI, et al., "Data Communication Network and Database Implementation Strategy for a Transmission Network Operation System," IEEE JSAC, Vol.6, No.4, May 1988
(6) Kisaku FUJIMOTO, Nobuyoshi AKIYAMA, "Switching Network Operation System," REVIEW of ECL Vol.36 No.2 1988

Lessons Learned in Signalling System No. 5 Applications and System Integration

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Abstract

Signalling System No. 5 is an analog system that was developed for dialing over the transoceanic Atlantic cables. It was then specified by the CCITT in 1964, and has gained popularity due to its ability to handle satellite traffic, which has also been growing in popularity. This paper will help its readers to better understand Signalling System No. 5 and the methods that have been used in various locations around the world to provide solutions to difficult communication needs. We will also describe in detail specific installations before and after implementation of Signalling System No. 5 in conjunction with a Redcom MDX Digital Central Office, illustrating our success at meeting customer needs with modern solutions.

Introduction

Communication: the imparting or interchange of thoughts, opinions, or information by speech, writing, etc.; the means of sending messages, orders, etc., including telephone, telegraph, radio, and couriers. Communication is an essential part of our lives. Without it we wouldn't be able to carry on business, pass on important medical information, or keep in touch with our friends and families. But we can't just think about communication in our own little corner of the globe. When we think about communication, we must think about overcoming language barriers if we are to communicate with people other than those in our workplace or home. And just as we must overcome language differences we must also overcome technology differences. As we travel from one country to the next, communication methods, technology, and regulations change. If we are to communicate between nations, we must address these issues.

This paper will address how one type of communication signalling system, Signalling System No. 5, has been integrated into a small class 5 central office, already supporting other types of signalling systems.

History of SS5

Signalling System No. 5 is an analog system that was initially a joint development between the UK Post Office and Bell Laboratories for dialing over the TASI (Time Assignment Speech Interpolation) equipped transoceanic Atlantic cables. This was the first application of intercontinental dialing with TASI equipment. Signalling System No. 5 was then specified by the CCITT in 1964, and has gained popularity as time has gone on. Part of this increased popularity can be attributed to the ability of Signalling System No. 5 to handle satellite traffic, which has also been growing in popularity. Much of the intercontinental world network, including transoceanic cables and intercontinental satellites, includes Signalling System No. 5 equipment. For this reason, it is imperative that modern capabilities be added to the network without the need for removing the current network. This would not only cost a great deal due to replacement of equipment already in place, but would also have the impact of disrupting communication time while equipment conversions were taking place.

At the beginning of the development of Signalling System No. 5, it was decided that the system should be as simple and robust as possible. This was due to the high cost of transoceanic cable. This is still true today, due to the high cost of satellite time. The system must be as reliable and durable as possible.

The line signalling for Signalling System No. 5, which is separate from the interregister signalling, is inband, continuous, link-by-link signalling. It is comprised of a single frequency of 2400 Hz, 2600 Hz, or a combination of the two. The interregister signalling for Signalling System No. 5 is 2/6 multifrequency, link-by-link, forward-only signalling. The signalling may be applied in a unidirectional, both-way, transit, terminal, semiautomatic, or automatic mode. Transit or terminal traffic is distinguished by separate KP digits. The system is suitable for 3 kHz and 4 kHz spaced submarine, land cable, microwave radio, and satellite circuits, with or without TASI.

Details of SS5

TASI is a technique used to perform statistical multiplexing. It multiplexes *n* circuits to *m* circuits, where *n* is greater than *m*, in baseband. This technique relies on the fact that there are pauses in conversations. The circuit is released during silent periods. When talking resumes, a free circuit is selected for transmission. It was originally developed for transatlantic submarine cable, which is very band limited. It was then applied to other voice transmission equipment. Signalling System No. 5 is a perfect signalling system to use with this technique because of the compelled handshake for call setup and release, and the fast MF signalling described below.

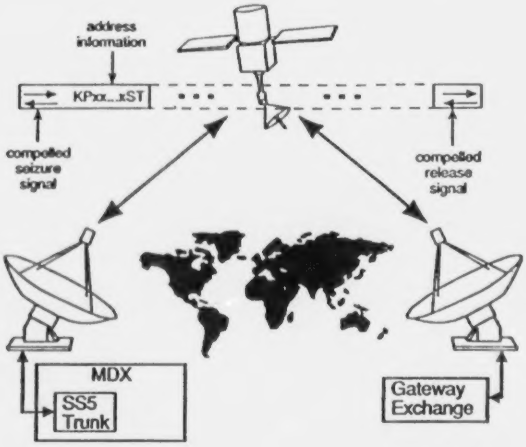
All but one of the Signalling System No. 5 line signals are continuous and compelled, so that the TASI trunk-channel association is always assured in the actual time required for the TASI function. The acknowledgment signal in continuous, compelled signalling increases the TASI signalling time and activity, but no penalty results from signals other than answer. And in the case of answer, a penalty would only arise when TASI is heavily loaded.

The interregister signalling is forward signalling only so as to minimize the TASI signalling time and activity. A TASI channel must be assigned prior to the address signalling to avoid clipping of the first address signal. Interregister signalling is sent in block format to allow validity checking to be performed. The TASI speech detector hangover maintains trunk-channel association during the gaps between successive address pulse signals; therefore clips do not occur. In order to make these gaps as short as possible, MF signals are sent at a faster rate for Signalling System No. 5 than for North American R1 MF signalling.

Signalling System No. 5 supports five sets of compelled signals. These are seizure/proceed-to-send, busy flash/acknowledgment, answer/acknowledgment, clear back/acknowledgment, and clear forward/release guard. It also supports one non-compelled signal, forward transfer. Busy flash performs a unique function in Signalling System No. 5. Since the equipment used in Signalling System No. 5 is expensive and shared, it is important to minimize the amount of time it is occupied unnecessarily. This is accomplished with the busy flash signal. As soon as a busy condition is detected anywhere along the path, the busy flash signal is sent, and the path is cleared down, leaving the responsibility of the busy condition tone to be supplied by the originating central office. (Refer to Table 1.)

Integration of SS5

A typical setup for an end office requiring Signalling System No. 5 might consist of toll trunks routed through an optional set of tandem offices, in turn routed to a gateway office and then to the satellite or cable using Signalling System No. 5. If the gateway office did not support Signalling System No. 5, the end office, or some tandem office along the path to the gateway office, would require signalling converter cards to convert the originating signalling protocol to Signalling System No. 5. (Figure 1)



In SS5 signalling, compelled line signalling is used, and the address information is sent *en block* so that satellite delays, echo suppressors, and TASI (a statistical multiplexing technique) will not disturb call setup and teardown.

Figure 1
Signalling System #5

In order to supply the special needs of Signalling System No. 5, much special equipment is often needed. For example, if Signalling System No. 5 were to be installed in a central office that was equipped with E&M trunks for North American R1 MF signalling, the following special equipment would be needed. A signal converter would need to be placed between the E&M trunk and the TASI equipment or satellite dish. The originating switch would need to be equipped with support for the unique busy flash signal. Faster MF sender/receivers would need to be supplied to handle the faster rate of MF interregister signalling for Signalling System No. 5.

Moreover, to supply a switch with the special needs of Signalling System No. 5 may not be all that is necessary to supply communication. The location of the switch is important information. Depending on its location, the switch may need to be capable of handling more than one type of signalling. For example, at a gateway it is not uncommon to need at least two types of signalling. If multiple types of signalling are needed, then the switch must be able to handle these multiple signalling systems.

Determining the types of signalling systems needed is not the end of the problem however. The standards to which the signalling system is adhering must be determined. What exceptions are there? What standards are not being followed? What unique standards have been inserted? There can be as many exceptions to signalling standards as there are governing bodies to determine signalling systems of communication systems.

Once the signalling systems have been clearly defined and their needs have been met, environmental needs must be examined. Environmental conditions can range from subzero temperatures of the arctic to tropical heat and humidity. Whatever technology is selected to meet the needs of the signalling system, it must also meet the wide and varying needs of the environment.

Redcom's MDX

Redcom Laboratories is a manufacturer of telecommunications equipment suitable for unique, environmentally unstable locations. Redcom's Modular Switching Units (MSU) are centered around a fully distributed control architecture. The MSU is the only stored program control switch in the market that does not use a central processor. By eliminating the central processor the probability of an all-out failure is reduced. Each 48-port MSU can function completely by itself or can be plug-connected to other MSUs to make a 384-port size system. Each MSU has its own microprocessor which supplies the control and communication within the MSU and communication to other MSUs. The MSU is a reliable, powerful system that allows 36 ccs of traffic per port. The MSU is mechanically configured to fit in a standard 19-inch rack. As a result, the MSU can be fitted into a wide variety of off-the-shelf standard cabinets. The MSU is ideally suited for a variety of environmental conditions. Its operating temperatures range from 0 degrees C to 50 degrees C ambient without fans or air conditioning.

Redcom's Signalling System No. 5 trunk and MDX-384 have solved many of the special concerns for Signalling System No. 5. All signal conversion is integrated into the Signalling System No. 5 trunk. Therefore, no external conversion equipment is needed. The unique busy flash signal and handling have been integrated into the MDX software, allowing it to work in conjunction with the signalling system(s) already in place. The faster MF sending/receiving has also been incorporated into the MDX software. Therefore the same MF sender/receiver hardware can be used for both Signalling System No. 5 and North American R1 MF interregister signalling. There is no need to purchase special MF hardware.

Reliability

Redcom's switching equipment is very reliable. The Mean Time Between Failure (MTBF) is 24.4 months for a fully loaded 48-port MSU. 75% of the failures encountered can be attributed to port cards, which will only degrade service for one port. 25% of the failures can be attributed to control cards, which will only degrade service for one MSU, not the entire system. Of all the cards returned, 25% have been diagnosed as "no trouble found". Another 25% are damaged due to external factors, such as lightning hits. 45% of the failures are due to component failures. And only 4% are due to workmanship.

Redcom's Variety of Signalling Systems

Currently Redcom's MDX offers a number of signalling systems. It supports North American R1 MF signalling, R1 Modified signalling, DTMF signalling, R2 compelled signalling, and Signalling System No. 5. NTT in Japan most recently purchased the Redcom MDX, using R1 Modified signalling, as emergency standby systems for their larger installations. Currently about 50% of the installed systems in Alaska are Redcom's MDXs. These switches use North American R1 MF signalling. Unitel in Canada has purchased several MDXs. They utilize DTMF signalling to provide long distance service with the MDX performing a concentrator function.

SS5 Sites

Redcom has three installed and working Signalling System No. 5 sites. One is located on Niue Island, one at Washington International Teleport, in Alexandria, Virginia, and one site has been installed in the Cook Islands on the Island of Aitutaki.

The MDX SS5 installation on the South Pacific Island of Niue services the local traffic and offers IDDD directly. The MDX has replaced a 100-line magneto manual switchboard. John Duncan, Director of Telecommunications for the Government of Niue stated, "I can say without hesitation that the replacement of the manual switchboard with an automatic switch in January 1990 had an immediate impact on business sector efficiency (both Government and private enterprise). Some private household subscribers also experienced the immense improvement of entering the world of modern technology for the first time."

Niue's application involves the handling of local traffic, much of which involves PABX hunt groups for their government agencies. 24-hour telex service is provided and all subscribers have automatic service being long-lined onto the Auckland Telex Exchange. Public booths are provided for non-subscribers wishing to use the telephone, facsimile, and telex services. A computerized customer billing program is used to provide monthly individual billing information to all Telecom customers.

In 1988, the Government of Niue took the first step toward upgrading their outmoded low quality telecommunication system. A bilateral aid agreement was signed with the Government of France to supply and install an INTELSAT D1 satellite earth station equipped to provide 6 voicegrade channels. Also the Government of Niue purchased Redcom's MDX. The exchange capacity purchased was only sufficient to automate Government offices, the business sector, and those individual line subscribers in the main town of Alofi, but the exchange is easily expandable. An expansion was ordered in 1990, and will enable all households in the main village of Alofi (including existing shared party lines and new subscribers) to be connected to the MDX. All villages outside of Alofi are still on shared party lines and poor quality manual service. Four remote villages are still using single channel VHF links with multiparty lines; sometimes up to 10 subscribers on one line. It is estimated that there are 250 people in villages outside of Alofi awaiting connection to automatic service. Future plans are to make provision for automatic service to the more remote villages by providing two remote automatic switches. It is also desired to increase the satellite station capacity from 6 to 12 international voicegrade circuits.

There has been a significant impact on the increase of revenue resulting from the conversion to automatic switching in the town of Alofi, and this growth in revenue is expected to continue as other villages are included in the expansion program.

Similarly, an MDX has been installed in the Cook Islands to link the island of Aitutaki with the rest of the nation. This switch also gives modern service to local subscribers. For many people on the island, this is the first telephone service they have ever had.

The earth station of Washington International Teleport (WIT) in Virginia is being interfaced directly to Italy via INTELSAT 4 with a small tandem MDX using Signalling System No. 5 trunks. WIT is the oldest and largest teleport in the U.S. With a central point for collection and distribution of information, WIT offers lower cost through shared resources, and flexible networking through a variety of technologies. WIT can reach any location in the world using a combination of fiber optics, satellites, or traditional long-distance carriers. WIT offers direct access to every INTELSAT service. WIT's local network, comprised of microwave and fiber optic circuits, covers Washington D.C., North Virginia, and Maryland.

Conclusion

In conclusion, communication is a very essential part of our lives. To communicate we must overcome language and technology barriers. Signalling System No. 5 is one means by which the gap between the older analog world and the newer digital world can be bridged. But Signalling System No. 5 has unique differences such as faster MF interregister signals and inband line signals. Redcom's MDX, with its embedded Signalling System No. 5, offers the world of Signalling System No. 5 an inexpensive way to upgrade its service to the digital world, as well as the many advanced features the MDX itself has to offer.

Signal	Direction	Frequency	Sending Duration	Recognition Time
Seizing	→	$f1$	Continuous	40 +/- 10 ms
Proceed to send	←	$f2$	Continuous	40 +/- 10 ms
Busy flash	←	$f2$	Continuous	125 +/- 25 ms
Acknowledgement	→	$f1$	Continuous	125 +/- 25 ms
Answer	←	$f1$	Continuous	125 +/- 25 ms
Acknowledgement	→	$f1$	Continuous	125 +/- 25 ms
Clear back	←	$f2$	Continuous	125 +/- 25 ms
Acknowledgement	→	$f1$	Continuous	125 +/- 25 ms
Forward transfer	→	$f2$	850 +/- 200 ms	125 +/- 25 ms
Clear forward	→	$f1 + f2$ (Compound)	Continuous	125 +/- 25 ms
Release guard	←	$f1 + f2$ (Compound)	Continuous	125 +/- 25 ms

→ Forward Signals ← Backward Signals $f1$ = 2400 Hz $f2$ = 2600 Hz

Table 1
SS5 Signals

Bibliography

1.CCITT Fascicle VI.2 Recommendation Q.140

2.CCITT International Signalling Systems

3.Niue Country Report; August, 1990

4.The Advanced Intelligent Network and The Central Office for the Rural Environment, by Klaus Gueldenpfennig

5.The power of global access, Washington International Teleport

6.The Telecommunication Needs of Rural Areas, by Klaus Gueldenpfennig

Tuesday, January 15, 1991

Morning Plenary

NOTES

LEARNING FROM COMPETITION

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Abstract

This paper describes KDD's experience in dealing with the severe competition that has been introduced into the international telecommunications market with unprecedented speed and intensity over the past two years, and outlines how KDD will employ the lessons learned thereby to cope with the forthcoming second phase of competition.

1. The Introduction of Competition

Throughout the postwar era KDD enjoyed a legal monopoly over international telecommunications in Japan. In 1985 the law was amended, and in 1989 two competing companies, ITJ and IDC, entered the market. Because of the events that led to their establishment, these new companies became known as "Daini KDDs'" or second KDDs.

The Daini KDDs were established as joint ventures by leading listed companies, which had previously been major users of KDD's services. Their basic concept for participation in the market was that they would start to provide services at rates significantly lower than KDD. They therefore limited their services to the lucrative areas of international private leased circuit services and international direct dialing telephone services. In addition, their initial entry into the market was characterized by an emphasis on services to high-traffic regions, such as the United States.

Through mass media coverage, the new companies rapidly publicized their claim to be 23% cheaper than KDD among users. In the international direct dialing telephone service market, which accounts for around 60% of KDD's operating revenue, we lost, in the first month after the new companies' entry into the market, about one-quarter of our share of Japan-U.S. IDD telephone traffic, which is the largest sector of the market. Competition was thus introduced with abnormal speed and severity compared with situation in the domestic telephone service market, in which NTT is now competing with three other carriers, or in the long-distance telecommunication market in the United States, which is now split between AT&T and two competitors. The principal reason for this is the fact that competition is based not on the selection of a carrier through presubscription, but rather on the simple choice of an international access code by the user. This has facilitated the shift of traffic to KDD's competitors and created an extremely competitive market structure.

Because of its role as a pioneer in the market, and in accordance with the competitive principle embodied in the amended law and the government's telecommunications policy, KDD supported the establishment of the two new carriers as a means of ensuring the healthy development of the international telecommunications market. At the same time, however, we could not afford to disregard the impact of this quick shift of the market share, and we reduced our rates not once but twice in six month's time, thereby eliminating most of the price difference. We also responded to competition through determined marketing efforts, including the expansion of our marketing organization and the development of new products. Subsequently the Daini KDDs reduced their rates slightly in response to KDD's actions, but at present it is not readily apparent which carrier offers the most competitive rates on a particular route or in a given time slot for any given service. I am happy to report that the pace of decline in KDD's market share has slowed considerably, and that an increasing number of users who initially switched to the Daini KDDs have since returned to KDD. This return of traffic to KDD as a result of our marketing efforts is all the more significant because we now operate in an extremely competitive market in which traffic can easily shift from one carrier to another. According to a report issued by the Ministry of Posts and Telecommunications, as of September, 1990 KDD held an 86% share of the international telephone service market, the Daini KDDs a 14% share.

Carriers are still competing to offer lower rates, but the size of reductions is gradually shrinking. Initially it was feared that the price war would continue indefinitely to the detriment of all the three carriers, but it now appears that the brakes are being applied. In addition, the past two reductions, together with those rates cuts implemented on an almost annual basis over the past decade, have brought Japanese rates down to below the level in most overseas service areas. Fortunately this reduction in prices has brought further dramatic growth in the demand for international telecommunications in the current year, and traffic is expected to increase sufficiently to compensate for most of

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the decrease in revenue due to the loss of market share and the reduction of rates. When reporting its results for the first half of fiscal 1990, KDD substantially increased its operating income estimates for the current year ending March 1991.

2. The Lessons of Competition

We are still in our second year of competition with the Daini KDDs. As I shall now discuss, however, we have already learned much from this situation.

First, there is the obvious fact that customers are extremely sensitive to price differences. This is apparent from my previous observation that the decline in the KDD's market share would probably have continued indefinitely if we had not reduced our rates to virtually the same level as our competitors.

However, we have also learned that users do not choose a carrier solely on the basis of charges. If rates were the only criterion, surely KDD's market share in the service areas that are subject to competition would have been reduced to zero.

This is particularly apparent now that there is virtually no difference between KDD's rates and those of its competitors. Although on the surface there seems to be little variation in the quality of services offered by different carriers in the field of international telephone service, reports indicate that in reality customer satisfaction varies considerably according to the call completion ratio, which means that factors such as the number of circuits maintained and the number of diversity routes available play a key role in competition. Today much depends on the total capabilities of a carrier, including its ability to provide a wide range of service options to meet the precise needs of userrs, the extent to which it can offer system integration services, the accuracy of its billing system, the speed with which it can handle complaints, and other customer support capabilities.

Although price competition with the Daini KDDs is likely to continue, it is possible that price cuts will merely result in a loss of revenue for the carrier, eventually leading to massive price increases. We have learned from experience that price cutting is meaningless unless it is accompanied an expansion of the market pie. At present the price elasticity of demand for international telecommunications is still high, and natural revenue growth can therefore be expected to continue. However, if the market remains highly dependent on business traffic, as was the case in the past, the Japanese market for international telecommunications will not be able to support sustained growth in the future. Hence, my second observation is that the development of the consumer market in step with the internationalization of the Japanese people and Japanese society is very important and an urgent priority.

Finally there is the question of our behavior in relation to regulation. KDD operated for many years as a monopoly enterprise, and for this reason regulation and KDD's business activities were two sides of the same coin. In this sense, we cannot deny that KDD relied on regulation when developing its business. However, we are now in a competitive environment, and the principle that guides our day-to-day business activities is above all competition in the marketplace, or in other words, our ability to meet the needs of our customers. If a particular regulation is incompatible with customer satisfaction, that regulation will sooner or later be bypassed, relaxed and eventually abolished. This is the accepted norm in today's world. While a minimal level of regulation must obviously be maintained, it is no longer appropriate to remain unnecessarily reliant on restrictions. The wisest behavior in this competitive environment is to anticipate the trend toward liberalization and deregulation.

3. The Future Development of KDD's Business

By way of conclusion, I should like to touch on some specific aspects of KDD's approach to the future development of its business in light of these lessons.

(1) The introduction of new services based on new technology

KDD has already started to provide ISDN services principally to corporate users for communications between Japan and the United States, Britain, France, Australia and Singapore. In addition to the expansion of this service to other regions, we will also strive to expand the range of supplementary services provided. Furthermore, we plan to start work on the introduction of broadband ISDN services in preparation for anticipated growth in the demand for high-quality audiovisual communications. We will shortly enhance our existing services through the introduction of the "VIRNET" virtual private network service, which is based on intelligent network (IN) technology.

We also plan to introduce telecommunications management network (TMN) technology in the area of leased circuit network services for business communications. This will lead to improvements in the reliability of operating maintenance, or one-stop maintenance.

Another priority area is the development of new services to stimulate demand growth in the consumer market.

The implementation of these new services requires cooperation with carriers, manufacturers and users with regard to research and development and international standardization, and we will continue to foster such cooperation.

We believe that even though R&D expenditures may place a temporary strain on management, they are nevertheless absolutely necessary, since without R&D there can be no survival in a competitive environment.

(2) The reinforcement of tie-ups with carriers overseas and the diversification of business

activities

In the past, end-to-end international telecommunication services could only be provided through the establishment of joint businesses (A-B model) among carriers. However, the continuing liberalization of the trade in telecommunication services has created an environment in which enhanced services can generally be provided under the A-A or A-A' model. The basic service category is also moving toward the provision of services on a "one-stop shopping" basis by groups of international carriers or under joint brands. In addition, multilateral forums of related carriers, such as the ABK or the Pacific Partners' Meeting (PPM), are expected to operate as mechanisms for the resolution of common regional problems. There has also been a trend recently toward the diversification of the business domains of telecommunication carriers to include the provision not only of simple transmission services, but also of high-value-added services and customer support activities, such as the supply and maintenance of terminal equipment. In order to adapt to trends like these, KDD will need to strengthen its tie-ups with carriers with which it has traditionally maintained relationships, while at the same time developing global activities independently or through affiliated enterprises.

(3) Development and expansion of underlying international telecommunication network infrastructure

The most fundamental duty of an international telecommunication carrier is to develop and expand underlying international telecommunication network infrastructure. The relaxation of East-West tension and the global growth of the information society are expected to bring explosive growth in the demand for international telecommunications in the future. In order to keep pace with this demand, it will be necessary to plan and construct large-capacity international digital routes, based primarily on submarine optical fiber cables, in order to ensure adequate capacity, icluding back-up capacity. The construction of submarine optical cables in the Pacific region began with TPC-3. The HAW-4, H-J-K and G-P-T have been completed, and there are plans for the construction of many more, including PACRIM-WEST, PACRIM-EAST, NPC, TPC-4, TPC-5, TPC-6, APC, JAPAN-CHINA-2 and JASC-2. These trends are expected to accelerate in the 21st century. As Japan's main international telecommunication carrier, KDD has played a key role in the implementation of these international joint projects, with the exception of NPC. We will continue to contribute in this way.

KDD is the Japanese signatory to INTELSAT and INMARSAT and has pioneered satellite communications in Japan. As with submarine cable communications, we are also playing a leading role in the development and expansion of new satellite communication services, such as VSAT (Very Small AnTenna) and aeronautical mobile satellite services.

(4) Technical assistance to the industrializing countries

Finally, we must also be aware of the importance of technical assistance to the industrializing countries. Because telecommunications is a high-tech industry, interest tends to focus on business activities among the advanced nations. However, we also need to provide the greatest possile assistance to the developing countries in their efforts to develop and expand their telecommunication infrastructure. Such cooperation is vital because of the need to ensure universality, interoperability and interconnectivity.

KDD has been providing technical assistance on a bilateral and multilateral basis for over 30 years, starting with the acceptance of trainees under the Colombo Plan in 1957. In addition to the donation of telecommunications facilities, the assignment of regional experts, the implementation of overseas group training programs, and the contribution of personnel and funds for the ITU technical cooperation agency, KDD is also fulfilling its responsibility in this area through the activities of the specialist organization that was established by KDD to provide engineering consultancy services to other countries. The continuing expansion of these activities reflects our continuing determination to respond positively to the needs of the industrializing countries.

An international telecommunications carrier cannot conceive of itself as merely a profit-making organization; it must also recognize that it plays an essential role in enhancing international communications and promoting relations between countries. In this sense, KDD could be said to be Japan's sole legitimate international telecommunications carrier. KDD fulfills this critical role by supporting the activities not only of global organizations such as ITU, INTELSAT, and INMARSAT but also of international organizations in the Asia-Pacific region, including APT, PECC and of course, PTC.

Telecommunications Reform for the 1990s: The Australian Model

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1. ABSTRACT

Australia is moving to full competition in telecommunications after 30 June 1997. Transitional steps include a second private sector competitor in 1991, full resale of capacity, and three Public Mobile Telephone Services licences. The regulatory authority, AUSTEL, will manage the transition from monopoly to competition.

2. INTRODUCTION

Nineteen ninety has been a watershed year of decision in Australian telecommunications. Nineteen ninety one will be the year of implementation of a new, more competitive telecommunications environment: the "Australian model" for the 1990s. The Australian Government's latest reforms in telecommunications represent the most radical restructuring of this key industry ever undertaken in Australia. These build on initiatives which have been underway since the Department of Transport and Communications was established in mid-1987.

In world terms, the package of Australian reforms represents an approach which has not yet been attempted in other countries, and I welcome this opportunity to use the Pacific Telecommunications Conference to present the Australian model to an international audience.

3. BACKGROUND TO THE REFORMS

Until the mid-1970s, Australian telecommunications services were provided by a traditional PTT, known as the Postmaster-General's Department.

In 1975 the Whitlam Government took what was then in world terms a pioneering step by breaking up the PTT into separate postal and telecommunications functions, known as Australia Post and Telecom Australia. International services continued to be provided by a separate entity, the Overseas Telecommunications Commission (now OTC Limited), which had been formed in 1946.

In the early 1980s, a separate satellite carrier, AUSSAT, was formed. AUSSAT was allowed to provide leased circuits, but could not compete with Telecom or OTC in their respective public switched services markets. Effectively, AUSSAT was limited to broadcasting services, data transfer for large organisations and non-switched traffic across the Tasman Sea.

The process of structural change in telecommunications was given a major impetus with the changes announced by the then Minister for Transport and Communications, Senator Gareth Evans, in May 1988 and implemented the following year. Under these reforms, Telecom and Australia Post were corporatised to preserve their commercial efficiency. As Statutory Corporations, they were expected to operate more commercially and at arm's length from the Government. At the same time, the Government established a new regulatory regime through the Telecommunications Act, with the regulatory arrangements reformed fundamentally. In order to separate the regulatory and carrier functions, a new independent body, AUSTEL - the Australian Telecommunications Authority, was established by the Government to assume the regulatory functions previously exercised by Telecom.

For the first time, Australia had a set of fully articulated objectives in the pursuit of telecommunications policy. A primary objective was to maximise the efficiency with which the publicly-owned telecommunications carriers delivered services to the community. At the same time, the Government recognised the need to ensure universal access to standard telephone services.

The Government's May 1988 reforms also foreshadowed the need for ongoing review of the arrangements it set in place. Perhaps the most important was a review of the structural relationships among the three telecommunications carriers, OTC Limited, AUSSAT Pty Ltd and Telecom Australia, which began in late 1989. At the same time, the Government reviewed its policy for private satellite earth stations and AUSTEL examined and reported on the sharing of private networks by common interest groups, the merits of opening the cellular mobile market to greater competition and the best way to introduce public access cordless telephone services.

Under the current Minister for Transport and Communications, the Hon Kim Beazley MP, the results of all these reviews have been brought together and proposals for change further developed. The outcome was announced by our Prime Minister, Bob Hawke, on 8 November 1990.

4. AUSTRALIAN TELECOMMUNICATIONS IN THE WORLD CONTEXT

The latest telecommunications reforms in Australia, of course, have not taken place in isolation. Australian telecommunications are very much part of world telecommunications and cannot be separated from developments internationally, whether these be related to new technologies or new approaches to the regulatory environment.

The early 1980s was a period of radical experimentation in telecommunications regulation in some countries, even to the point where some could be accused of taking a "leap now, look later" attitude. However, the latter part of the decade has also seen more measured approaches in a larger number of countries.

What might now be called the "Australian model" for telecommunications draws heavily on the experience in other countries, and I believe some important lessons have been learned.

- The transition to competition has the potential to cause a degree of confusion and can impose some inconvenience for consumers, particularly if the interests of consumers are not sufficiently protected. We aim, with the benefit of hindsight, to avoid imposing confusion on consumers and even more importantly to ensuring that the benefits of competition are equitably distributed among consumers. We will not permit cost and price reductions in the highly contested markets to be negated by price hikes in less accessible markets or compromises in service levels.

- When competition is introduced, it must be genuine and not confined to only limited sectors of the market. We will be careful to ensure, by strong pro-competitive initiatives (resale and a firm "sunset") and enhanced regulatory arrangements including comprehensive and explicit equal access arrangements, that the duopolists in our market in the period to 30 June 1997 have every opportunity and every incentive to compete strongly for market share across the spectrum.

- It is also clear from overseas experience that privatisation and deregulation do not lead automatically to competition if suitable pro-competitive mechanisms are not available at the outset to facilitate the transition from monopoly to full competition. We believe that there is a need to foster a degree of discipline and balance in the structure.

Another lesson which has loomed large on the telecommunications scene is that a "do nothing" approach means to march backwards rapidly. Whether we like it or not, there are technological imperatives which, in combination with new regulatory approaches, mean that to remain with old models and old ways of doing things will lead to relative stagnation and decline.

To be a world-class performer, the Australian telecommunications industry needs to have first order outlooks, practices and regulatory environment. This has been recognised by our Government in giving prominence to telecommunications as one of the key industries in its drive for micro-economic reform.

5. THE GOVERNMENT'S STRATEGY

In world terms, the "Australian model" for telecommunications reform is at the leading edge. The ultimate objective of the Australian Government is to improve telecommunications services and to reduce costs to consumers: both residential and business.

To do so, the Government has decided to introduce genuine and wide-ranging network competition into the telecommunications industry. This involves a progressive timetable through to 30 June 1997, involving a number of transitional, but significant steps:

- the establishment by the end of 1991 of a private sector competitor to a merged Telecom/OTC in the provision of network facilities

- the introduction as soon as practicable during 1991 and 1992 of vigorous competition in the provision of services:

- introduction of full resale of domestic and international telecommunications capacity. In other words, the current distinction between value added services and reserved services will be eliminated;

- three Public Mobile Telephone Services (PMTS) licences will be issued, including one to AUSSAT prior to its sale to the second carrier and one to Telecom/OTC;

- the provision of Public Access Cordless Telephone Services (PACTS) will be opened to full competition in accordance with the recent recommendations of AUSTEL.

- the issue of further mobile (PMTS) licences will be considered in 1995

- from 30 June 1997, there will be no restriction on the number of network providers or installers of network infrastructure.

There is a strong rationale behind these steps. The Government is operating from the perspective that the licensing of a second carrier will not, of itself, guarantee automatic benefit to consumers. Overseas experience has revealed clearly that when dealing with an environment where there is an entrenched, monopolistic market structure, it is not sufficient to simply privatise or deregulate to engender competition and community benefits. We are therefore adopting a careful approach designed to provide safeguards against predatory behaviour by carriers with dominant market power, and to overcome structural barriers to competition which have developed, quite naturally, under monopoly provision of services.

The cornerstone of this approach has been the Government's decision to implement a comprehensive range of transitional regulatory arrangements designed to safeguard the capacity of new players to enter the various sectors of the market on a fair, competitive basis.

6. AUSTEL

Consistent with the Government's recognition that genuine and effective competition does not automatically flow from deregulation, the role of AUSTEL will be enhanced. Behind this is a philosophy that a regulator is needed, not for its own sake, but to manage the transition from monopoly to competition. AUSTEL's specific powers, particularly in relation to arbitration where carriers cannot reach a commercial agreement, will thus be clarified and strengthened to ensure that the Government's policies are implemented effectively.

AUSTEL's major functions to date have been technical regulation, promotion of fair and efficient market conduct, protection of customers, and assisting the Department of Industry, Technology and Commerce with the implementation of industry policy objectives. Under the new legislation, AUSTEL will have an important new focus. It will have a mandate to actively promote competition within the regulatory framework established by the Government. As part of this mandate, it will report annually to the Government on all arrangements for competitive safeguards, carrier performance, including customer satisfaction, and customer benefits such as quality of service. In operational terms, all interconnection charges for the use of Telecom/OTC facilities by the second carrier will be subject to review and arbitration by AUSTEL. AUSTEL will also assume prime responsibility for managing Australia's input to the setting of international telecommunications standards, and for preventing the misuse of market power by international carriers supplying services to and from Australia.

7. IMPLEMENTATION STRATEGY

The Government has presented the Department of Transport and Communications with a complex package of reforms to be implemented. In order to implement these reforms effectively, consultative mechanisms have been established to maximise the potential benefits of the reforms. The Department has undertaken extensive consultation between industry, consumer groups and policy makers on the review of the telecommunications industry, the implications of reforms and legislative proposals. This consultation is ensuring the widest possible consideration of the requirements of interested parties in the formulation of the new policy, and is an essential ingredient to the whole process.

The actual approach to implementing the reforms involves three streams of activity:

- Change to the regulatory environment;

- The merging of OTC and Telecom into a public company;

- The licensing of a privatised second carrier based on AUSSAT.

Legislation is currently being prepared and next month we propose to consult with industry on the "exposure draft" of the Telecommunications Act Amendment Bill. The target is for the Minister to take the Bill to Parliament in late March/early April, with passage expected to occur sometime in the May/June 1991 period. If this schedule is adhered to, then the

Telecommunications Act 1991 would come into force in July.

The merging of OTC and Telecom commenced with the appointment of an "Interim Board" by the Minister for Transport and Communications. This Board has been charged with advising the Government on the establishment of a new corporate and management structure to facilitate the merger of the two organisations and oversee the introduction of the required interconnection arrangements. Its primary focus is to prepare Telecom and OTC to face a competitive environment.

A Corporation Bill is due to be introduced to Parliament at about the same time as the Telecommunications Amendment Bill. The merger will not be finalised until after AUSTEL has certified to the Minister that the appropriate interconnection arrangements to the second carrier are in place.

8. SELECTING A SECOND CARRIER

I would like to emphasize the importance of the process of selecting a second carrier. This is an integral part of the policy framework.

First, this is not just a sale process. That implies a handing over of control, a divesting of responsibility and consequential collection of revenue. What we are doing is much more ambitious and planned than this. We are not "used satellite" sales people and this is not a "fire" sale.

Second, we have deliberately shied away from describing the process as an investment opportunity. Obviously it is, but there is much more to it than that. If we had been primarily about attracting the highest possible sale price, we would not have introduced a third mobile licence, allowed resale or had the 1997 sunset provision.

What is it, then? Perhaps a helpful way to describe it is to draw on our Minister's experience in his previous portfolio, Defence. During his tenure there, several major contracts were developed and implemented, including the purchase of frigates for the Royal Australian Navy. The life cycle for this project extends well beyond the year 2000, going from initial design, through choice of supplier to construction in Australia and final delivery of the frigates. There will also be significant transfer of technology.

The same is true regarding the choice of a competitor to Telecom/OTC; it is intimately bound up with the delivery, over time, of a viable alternate telecommunications infrastructure within Australia. The tool we are using to guarantee delivery of this infrastructure is to license the second carrier. I believe our approach is a first in the telecommunications world, where to date privatisation in other countries has focussed on the sale of the dominant carrier and then allowing competition. This may maximise a state's revenue, but it doesn't necessarily achieve a high level of competition. Experience elsewhere reinforces this point.

The selection process, then, though it is to be completed by the end of this year, is really about delivering a viable, efficient, cost based telecommunications network over a six year time period. By 1997, Australia will have a modern, expanding and competitive alternative to Telecom/OTC. In return, the successful bidder will be well established in a market with a very high telephone penetration rate, sophisticated in its telephone usage and ideally suited as a business hub for the region.

An important point to note, too, in this selection process is in the first stage of inviting expressions of interest we are seeking to establish a dialogue with interested parties on some key policy issues still to be resolved. This is consistent with an overall principle underlying the whole task of implementing the new carrier arrangements, namely that of consultation between policy makers and interested sectors within the economy on the detail of the final product.

The selection process will be demanding and complex and I can assure you we will drive a hard bargain. We see the process as both a beauty contest and an auction, but at the same time we will be examining what the "beauty" will look like in five years time and whether then it will still be value for money!

A few final words about the selection criteria, to help give dimensions to the complexity of this project. Network roll-out clearly is important. This, together with proven managerial and technical competence in telecommunications operations, will provide a litmus test on how quickly effective competition would be introduced. Next, proposals covering Australian industrial participation and plans for Australian equity participation in the longer term will be examined closely. Finally, of course, there is price.

Weighting our selection criteria may require the wisdom of Solomon, but we are looking forward to it. I hope next year we will be able to report on the successful outcome of this task.

9. CONCLUSION

In this address I have provided only a summary of what is in reality a very complex task which involves high stakes

for all participants - the Government, the existing carriers, potential holders of the second and third PMTS licences, other potential industry participants, and most of all the Australian telecommunications consumer.
I would like to stress that the Australian Government truly intends to foster a competitive telecommunications environment - there is no hidden agenda. Potential industry participants will need to have a strong commitment to the task, a good ability to read the market and a strong vision of how they can participate productively in the Australian telecommunications industry.

The efficiency of Australia's telecommunications industry is a major factor affecting the competitiveness of the entire Australian economy. It is also an essential service for nearly every Australian household. These reforms will ensure an environment for a more competitive and efficient telecommunications sector, both in terms of delivery and choice of service, and technological development. Under such an environment, Australia can expect to experience continued growth as a regional "hub" for telecommunications in the Asia-Pacific region. The benefits of getting the competitive structure and the regulatory environment "right" are very significant and the Government is confident that in fostering a new Australian telecommunications environment, it has done exactly this.

We have an American on the staff of the Department of Transport and Communications who says that one of the key words he uses when trying to pick out a particular Australasian regional dialect is the word "model" - to him, those who speak it always sound like they are saying "muddle". That's one thing that we're trying to avoid. Other countries can have a muddle, if they want one, but we are confident that the Australian telecommunications model will be exactly that - a model that in world terms will be held up as an example to those countries trying to find a way out of a muddle.

In the end, we hope Australian telecommunications will indeed be seen by the world as a "model" for transition to an open, competitive and efficient market structure.

Convergence Technology Transfer & the Pacific Rim

Ernst Wellhoener

ABSTRACT

This paper will address the opportunities becoming available from the convergence of the computing and telecommunications industry. In this process there are major opportunities for both the Pacific Rim and emerging nations to benefit directly within their own infrastructure development and to access the world trade and technology transfer networks, through partnership with global computing and communications companies.

When the large basal plates, of which the earth is apparently composed, collide, they tend after much huffing and puffing to throw up large mountain ranges. Pieces of each plate are reorganized some are interchanged, some are actually merged, i.e. creating shale. Mountain ranges in and of themselves are extremely useful, they are a water source, climate creator, you can farm them etc. However, the most successful use, so far, had to wait for another type of plate - the industrial revolution, which brought with it mass transportation, free time, expandable income and need for recreation. It is only in the last 40-50 years that the Swiss for instance, have discovered the real potential of living on the edges of colliding plates - the snow industry, skiing, climbing, apres-ski etc. This is now the one of the major sources of revenue for this and other countries. Incidentally it was initiated by a non-Swiss who came from a fundamentally flat country, but who could see the potential of these plates in collision.

Let me use this graphic illustration to talk about the future of convergence in the T/C and Computing Industry.

I don't want to stretch the analogy too far but is seems to me that what we have been seeing over the past few years has been the collision of two major industries and the de facto creation of a new mountain range from the so-called convergence of these two industries. Over the past few years there has been much debate, argument and positioning on the subject of convergence - where, when and how do the computing and communications industries, capabilities and products get together. The debate centered around both technical and market issues. Thus, there have been the massive moves by large computer companies to buy into and/or build telecommunication switches and transmission products, telecommunications equipment vendors reciprocating with the purchase, building or allying with small computing companies. Both of these attempting to become carriers or van operators, at least in the niche spaces and of course new entrants in all fields, and major upheaval in the standards field. A further complication factor has been the release of most of the worlds PTTs (or TSPS) from the constricting corset of overmuch regulation; each of these in turn searching for new roles and functions.

The market, too, has been changing, moving away from the monolithic single structure company (laden with bureaucracy and centralized systems) to more global, efficient, effective and flexible customer friendly units, which now are beginning to use the current convergence for electronic trading. Over time most of the world's business and trading will move to electronic form. As in all such debates there has been a lot of smoke, snake oil and some real issues. This past debate, however, was in my opinion the first phase or wave of a very important movement and of course like the plates will keep moving and changing. There is also I believe another plate in fast motion about to collide, let's call it the info-media plate, which is already and will increasingly change the shape of this new infrastructure.

Let me go back to my analogy in Earth sciences: while all of this is beneficial in a low key way it has not really begun to exploit the potential of these facilities. We do have improved communication, networked computers, VANs, VAS and the beginnings of an intelligent network, and the start of personal mobile communications. We are really only beginning to develop a snow industry on the mountains of computing and telecoms.

For instance, I actually need one unique telephone number that finds me wherever I am, avoids having my wife, child and others acting as a switchpoint, a computing capability that can do all the enabling activity for me to allow me to focus on what I really want to do, i.e. the content not the access.

As I would find it impossible to book all the details of a ski holiday - the hotel, the airline, the ski lift tickets, even the videos I have available, I use the travel agent. In my case of this current converged telecoms and computing arena, we are only beginning to develop the equivalent of agency and all the other services, to enable me to have a complete package from one single simple point. Here is a major opportunity for new work and revenue, both of which can be done anywhere in the world.

Users are beginning to realize that the electronic world basic building blocks are now in place and that they need to start planning for this world. The more advanced corporations and individuals are now saying three things, since they also want to operate globally.

1) A riskfree environment in which to do computing - and from the telecommunications industry point of view - communications. From this perspective they don't care how much it costs and they don't care who does it as long as it is riskfree. They want to be guaranteed to be able to do anything, anytime and anywhere they want to do it. (Just the same as a good travel agent.)

2) Where the cost part comes it is that they also want to be able to buy any particular point product or point service they find in the market place and they want it to integrate and protect past investment. Corporations want it to be usable throughout their company network worldwide regardless of who they bought it from and regardless of what standards the original manufacturer has followed. So the combination of those two things provides the flexibility that companies want.

3) The other element is the user ability, maybe on a flexible profile base, to put together combinations of products and services (or parts of services) on an expense base any time, from anywhere, for his own particular use profile. This of course changes dramatically at each point in the day, i.e. total flexibility through a single, simple service point.

If this is so, that both the telecoms and computing industry can work together and users are beginning to see it, where does this take us. Let me move into the near future vision. If we assume that the open information infrastructure will take place, that order is emerging from the apparent chaos, as we move to the next stage of convergence

then we would assume that eventually from the user's perspective you could treat the entire information and communications industry as utility. So you would be able to interconnect with some magic cloud utility there, just like today's telephone system. It would do what you wanted to do and communicate with who you wanted to communicate regardless of addressing conventions, where or who supplies the services. Regardless of whether it's for data, voice or image.

Let's look at a computer user.
From this point of view we would like to think that there is this little plug in the wall which has a set of little cables behind it depending on what kind of device you are connecting and we would like to access all of the capabilities of the computing world, all of the people in society, all of the data for a fee if appropriate. You would like to do that with the desktop appliance of your choice : the workstation, the PC or the terminal or even your intelligent telephone or entertainment system. From your point of view you don't much care whether it is your MIS department or the PTT or DEC or who ever that are supplying that service.

Some of this capability is becoming available on the more sophisticated internal F500 company networks, but the real art will be to interconnect to other companies and users, and other countries. Other parts of the world will also need to participate not only in the development of this utility but also absolutely need access to such utility if they are to play the full role in the world.

All of this is a good vision, but we still have a long way to go to see it implemented.

But even with this model of the future, there is a risk that we will not use this technology advance to really change the world. (I'm reminded that Isaac Aszinov, that most prolific of writers, once said, "For a technological advance to be truly basic, it must change the entire world not merely a single nation or a single class.") The risk is that the (over) developed world (USA, Europe and Japan) will move so fast that the world electronic network will be hubbed from these three centers with the rest of the world as clients, merely as servers. It is my belief that whilst this might be profitable in the short term it will be disastrous in the mid and long term. As those of us who have worked extensively in telecommunications and networked computers know - a distributed system with many added value nodes is the most efficient, effective and flexible architecture. This brings me back to one of the theme of this conference - Technology Transfer.

One of the key lessons we learned in the first wave of convergence between our two industries (computing and telecommunications) is that technology transfer (actually knowledge transfer) can only really be done if applied to solve a third party's problem. We spent endless time and effort exchanging details of specs and protocols, but it wasn't until we involved a joint customer - working to solve his or his customer's problem that we made progress, - progress in the sense of understanding the knowledge (what it meant) and its boundaries. I'd like to suggest that the same could be true in technology transfer in the Pacific Rim.

There are two immediate areas that are necessary for development in order for all countries to be real players in the Electronic World.

The first is the development of the local infrastructure, not just the physical network but also the regulatory conditions (so that the local infrastructure may become a true nodal point in the electronic world). The second is the area of additional services that can be built on top of that local infrastructure to really serve the particular needs of local and non-national industry.

In order to build these additional services on a world class scale it is becoming apparent that intimate knowledge of the capabilities of the basic infrastructure is vital. (To go back to my starting metaphor, if you are going to build ski resort you need to know your mountains and its conditions very well indeed.) It is possible of course to just buy the products and have them installed - but that's all you've done - there is no real technology transfer, no risk sharing, no further commitment from the vendors to develop your goals.

What we have observed in the other parts of the world, where regulations have changed to allow innovation and new thinking, is that successful companies are those who have developed a partnership approach with both the telecoms and computing companies. These partnerships are of the form that ensure that each member brings its full resources to bear on the initial problem, i.e. building the correct infrastructure. This type of partnership is also the easiest way of knowledge transfer since all take a risk in the market for that infrastructure (the potential of losing really focuses the mind) and all share in the rewards. From this base it is easy to move with one or all the partners to provide solutions to the infrastructure users' needs.

There is currently a world wide shortage of applications and new technology to solve many problems both in the infrastructure and for its users. What we also find is that many of the applications necessary in a particular situation suitably modified can be resold profitably elsewhere - the partnership approach also provides a global distribution capability. These applications run from OSS, PNM to IN services.

In summary, development of the local infrastructures is vital, but we all have issues of cost, skills and revenue. Our view, which I think is shared by the other players in the industry, both telecommunications and computing, is that this development is best done through real risk sharing partnership. Partnership which assists local development rather than just a buyer vendor relationship. Putting the base technology together is now relatively simple, - the first wave of convergence but designing and developing the base applications is critical, we need new OSS, network management and IN systems and services. Working together with local companies, Digital helps develop these applications not just for local implementation, but for resale elsewhere. I would suggest to you that working together with large companies is a way of achieving technology transfer, beginning to solve current problems and hopefully making money for all of us.

The second area we have to address, and this is just beginning, is to develop the new uses other non-telecoms and companies such as banks, traders, etc. need to run and operate their business on a global basis. To go back to my starting analogy, this is the development of the snow industry in the mountains of computing and telecommunication. Here applications are key, there is a world shortage of capability; again working together with people such as ourselves and the end user in partnership is a way of solving this problem and providing technology/knowledge transfer and generating joint revenue.

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TOSHIBA'S IN-HOUSE SATELLITE COMMUNICATIONS NETWORK SYSTEM AND SATELLITE NETWORK FUTURE SERVICE

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1. ABSTRACT

Satellite communications have been attracting wide attention mainly from the visual services because of the excellent features such as wide-area coverage broadcasting nature and wideband characteristics. Toshiba has already composed a Toshiba in-house satellite communication system (briefly,TS-NET) in January, 1990 while launching regular operation. Services available through the TS-NET include the remote education system for works and offices separately located, multipoint videoconferencing system to which more than 3 stations can participate, remote maintenance systems and exposition systems connecting several demonstration site and works using mobile stations,product presentation meeting broadcast to all works and the image distribution systems for video company magazines.

2. Toshiba Outline

Toshiba retains about 600 group companies including 25 works, 13 research laboratories and 63 branch and sales offices in Japan while maintaining 25 offices, 20 manufacturing and companies and sales companies and 36 overseas sales companies in foreign countries Toshiba is one of the general electrical manufacturers and covers business fields of information and communications systems, heavy electrical machinery, consumer appliances, electronic devices, etc.

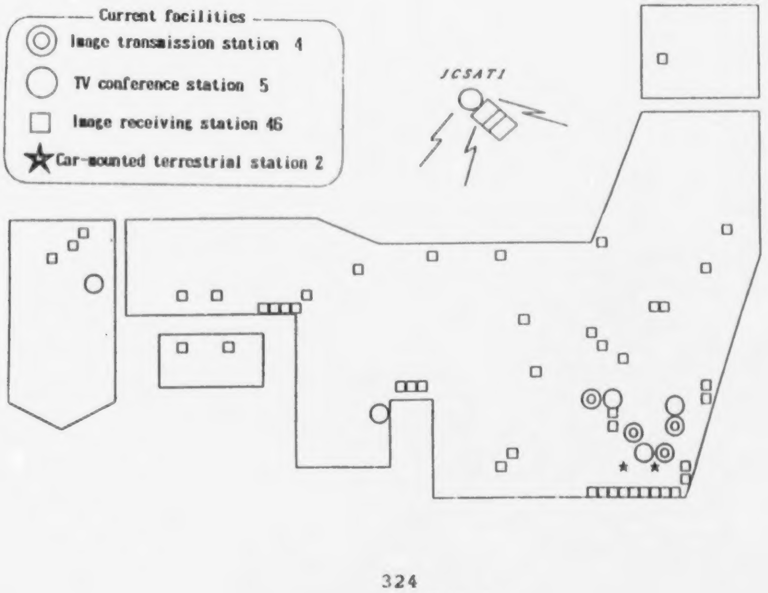
Thus, Toshiba's business field is so wide as its business bases being broadly overseas as well as in Japan. To support business activities of the company in the world,general communications networks and trunk information systems have been composed to connect and interface domestic and overseas works and offices. Among others, the TS-NET is operated as in-house communications systems to provide people working in Japan quickly with and latest knowledge and information.

3. Background of Using Satellite Communications

In Japan, private satellite communications companies named Japan Communications Satellite Co.,Ltd. (briefly,JCSAT) and Space Communication Co.,Ltd. have been newly organized since the electrical communications business has been liberalized.

Compared to conventional terrestrial systems,satellite communications are more excellent in broadcasting nature,mobility,wideband characteristics and antidisaster properties, as a new communications infrastructure. Since Toshiba retains business works and offices widely distributed all over Japan and is one of the satellite communications equipment manufacturers,such a communications infrastructure is needed as capable for quickly transmitting new informations on business policies and plans, to all employees working in the frontiers of sales and manufacturing in order that we can survive in modern ages where the circumstance are changing day after day. We also noted that, in order to sell satellite communications equipments to clients, we have to completely use the systems with a complete line-up of know-how for system composition and operation. As a result, we decided to introduce the TS-NET.

FIG1. IN-HOUSE SATELLITE COMMUNICATIONS NETWORK(TS-NET) CONFIGRATION


Current facilities
◎ Image transmission station 4
○ TV conference station 5
☐ Image receiving station 46
★ Car-mounted terrestrial station 2
JCSAT1

4. Overview and System Configuration

The TS-NET is composed of various subsystems such as earth station equipment, videoconferencing system, image transmission, remote education system and network control system. Figure 1 provides the network configuration and Figure 2 shows system configuration.

4-1 Network Composition

(1)The network is composed at present of 4 image transmission stations,5 multipoint videoconferencing stations and 46 exclusive receiving stations. Each image transmission station is capable for transmitting latest and fresh information towards the entire company and constructed in the works and offices of advanced technology. A part of the image transmission station is proved also with the multipoint videoconferencing function.

(2)Among other stations, the remote education transmission station is located at present in the head office building and Toshiba Training Center from which sales and in-house education information is transmitted towards the works and branch offices in Japan.

(3)The multipoint videoconferencing is a system to which several stations can participate, thanks to the broadcasting nature of the satellite communications. Each Toshiba's sales division administrates several works, so the conference system is one of the most effective communication tools with which necessary information can be exchanged. At present, a total of 8 stations is operated, including 3 stations having the multipoint videoconferencing function and 5 multipoint videoconferencing station. The system has been effectively used to assure quick responses and actions.

(4)The satellite communications monitoring center has been constructed in head office and is centrally controlling the TS-NET by means of the network control system (SNMS), which saves the operator's work at each site. For the control,the network in the earth systems is used to set and reset communication channels based on reserve information.

4-2 Use of Transponder

In the TS-NET, transponders are operated in order that many users can utilize them at the same time and in various ways divided by means of :

- (1)Frequency division system
- (2)Hybrid transmission system
- (3)Data compression system

The division pattern of transonder in use is (see Fig.3):

- (1)Band of full moving picture
  Used to transmit image and remote education
  •Time zone not in use
  (Daytime) Videoconferencing
  (Night) Data transmission
- (2)Multipoint videoconferencing
  The 384 Kbps compression moving picture system.
- (3)Band used for data transmission
  Used to transmit various data and back up.

4-3 Protection of data

With the TS-NET,both analog and digital data are transmitted , etc. However, no information is stored in system. Therefore accidental data breakdown may occur only in the SNMS which monitors and controls the networks. Once the SNMS fails,all networks are deactivated. In addition provided with the plan emitting electric waves from the earth station may also be broken. Consequently, the SNMS has been duplicated to withstand physical damages.

Since communications with the satellite are processed in electric waves to carry information. Therefore anybody can receive it, so it is particularly important to keep secrecy of transmitted information.
With the TS-NET, image and digital socrecy system to transmit image and digital signals, respectively.

5. Overview on Subsystem

5-1 Equipment in the earth station

The equipment in the earth station consist of an antenna devices, transmission & receiving equipment and terminal devices. In the TS-NET, each station is composed in different configuration according to communications capacity the number and type of terminals. In the head office, FM TV signals and data signals are transmitted at the same time, so the high power amplifiers (HPA) of 200W and 85W are operated in combination. The specifications of the equipment, apparatus and devices are shown in Table 1.

Table 1. Specification for the earth station equipments

Equipment	Specification
Antenna Equipments	Diameter of antenna: 5 m Gain:Transmission = 55.4 dBi Receiving = 54.8 dBi
Transmission & Receiving Equipments	Operation in combination with 200W and 85W high power amplifier Frequency Transmission:14 - 14.5GHz Receiving:12.25 - 12.75GHz IF-frequency:140MHz,1GHz band
Terminal Equipments	FM-TV modulator 384Kbps modem 64Kbps modem SCPC FM modem

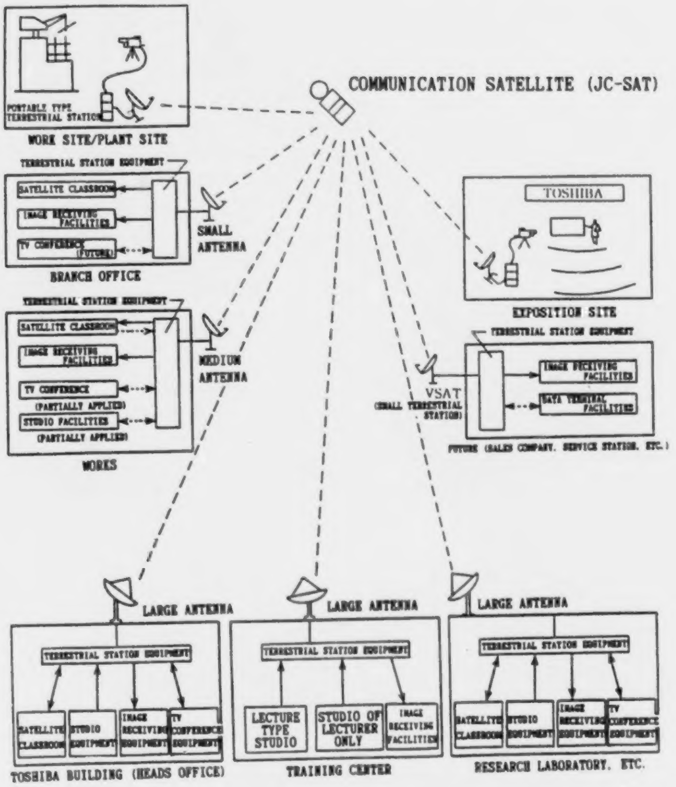

COMMUNICATION SATELLITE (JC-SAT)
PORTABLE TYPE TERRESTRIAL STATION
WORK SITE/PLANT SITE
TERRESTRIAL STATION EQUIPMENT
SATELLITE CLASSROOM
IMAGE RECEIVING FACILITIES
TV CONFERENCE (FUTURE)
SMALL ANTENNA
BRANCH OFFICE
TERRESTRIAL STATION EQUIPMENT
SATELLITE CLASSROOM
IMAGE RECEIVING FACILITIES
TV CONFERENCE
(PARTIALLY APPLIED)
STUDIO FACILITIES
(PARTIALLY APPLIED)
MEDIUM ANTENNA
WORKS
TOSHIBA
EXPOSITION SITE
TERRESTRIAL STATION EQUIPMENT
VSAT
(SMALL TERRESTRIAL STATION)
IMAGE RECEIVING FACILITIES
DATA TERMINAL FACILITIES
FUTURE (SALES COMPANY. SERVICE STATION. ETC.)
LARGE ANTENNA
TERRESTRIAL STATION EQUIPMENT
SATELLITE CLASSROOM
STUDIO EQUIPMENT
IMAGE RECEIVING EQUIPMENT
TV CONFERENCE EQUIPMENT
TOSHIBA BUILDING (HEADS OFFICE)
LARGE ANTENNA
TERRESTRIAL STATION EQUIPMENT
LECTURE TYPE STUDIO
STUDIO OF LECTURER ONLY
IMAGE RECEIVING FACILITIES
TRAINING CENTER
LARGE ANTENNA
TERRESTRIAL STATION EQUIPMENT
SATELLITE CLASSROOM
STUDIO EQUIPMENT
IMAGE RECEIVING EQUIPMENT
TV CONFERENCE EQUIPMENT
RESEARCH LABORATORY. ETC.

FIG. 2 CONCEPT OF SATELLITE COMMUNICATIONS NETWORKS
CHARACTERISTIC VIEW OF TS-NET NETWORK CONFIGURATION

Figure 3. DIVISION PATTERN IN TRANSPONDER

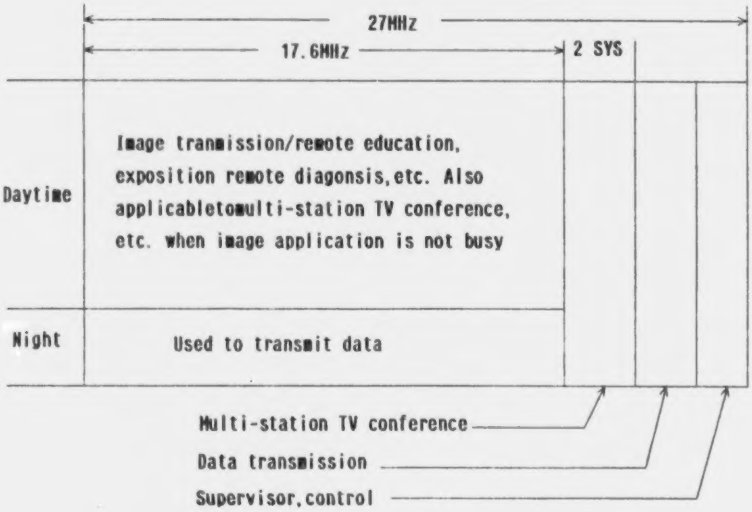

27MHz
17.6MHz
2 SYS
Daytime
Night
Multi-station TV conference
Data transmission
Supervisor, control

Image tranmission/remote education, exposition remote diagonsis, etc. Also applicabletomulti-station TV conference, etc. when image application is not busy

Used to transmit data

5-2 Video Videoconferencing System

(1) Overview

This system consists of chairstation, speaking stations participating directly in the videoconferencing with the chairstation and attending stations that can watch the conference. (The attending stations can orally participate in the conference.) Thus, the system provides a conference with a minimum of one versus one stations to a maximum of 20 stations. For the first year, the system has been introduced into a total of 8 works and offices that will be additionally introduced in the future. This videoconferencing system has been developed and introduced talking advantage of satellite communications particularly in its broadcasting nature, because Toshiba has a number of remotely located business bases. The general view of multipoint videoconferencing room is shown in Fig.4.

(2) Major functions and features

- The terminal package for videoconferencing is operable simply only by turning the power supply ON.
- The monitor screen size is 32 inches with the function to display particular persons,etc. in splitting for each station and its counterpart stations (see Fig. 5).
- High-quality voice sound has been realized in combination with the voice sound in a wideband of 7 KHz and an echo canceller.
- Preprints required on the way of the conference can be distributed through G4 FAX at high speed.
- Video cameras in counterpart stations as well as in each station can be remotely manipulated using the wireless operation device. Thus close-up view in the transmission station and the aspect of entire conference can be watched.
- The confidential talking function in use can prevent the leakage of voices spoken in each station into other stations.

5-3 Image Transmission & Remote Education System

(1) Overview

In the image transmission services, moving picture are broadcast form an image transmission station to all over Japan for the purpose of in-house propaganda and product sales,etc. Qualified receiving stations are assigned by the secrecy system.

The remote education services is intended to educate people in works and offices remotely located by connecting them through this system in which lectured details are transmitted in moving pictures while transmitting still pictures of education texts, etc. Limited stations are provided with such a functions as transmit the view of classrooms,image of trainees and voice of questions into the studio of the lecturer. Thereby, the seminar is operable more naturally. Like the image transmission system,qualified receiving stations can be assigned by the secrecy system. Figure 6 shows system chart for image transmission and remote education service and Figure 7 shows the general view of remote education classroom.

The image transmission system is applied the following:
- Broadcasting of "TV Toshiba" (in-house PR video magazine) to all distributed Real-time transmitting is also planned in the future.
- Addresses of the top management are on-aired to notify company policies and strategies. The remote education is applied to:
  - Technical and SE education
  - Education for internationalization
  - Sales and product knowledge education
  - Job knowledge education,etc.

(2) Major function and features

The education like a live seminar is operable using large monitor screens.
- The equipment in the transmission side is housed in a simple type studio suitable for limited applications in house. The equipment is operable to transmit data using a minimum number of personal in simple procedures of operation (image transmission station).
- Receiving stations are selectable by the secrecy system.
- Moving and still pictures are used together.

5-4 Exposition Remote Maintenance System

This image transmission service can distribute image information to all over Japan from mobile station SNG and SNV. Receiving stations are assigned by the secrecy system and can watch transmitted image.
Prospective applications of the system include:
- View repeated from an exposition at their offices located any place in Japan.
- The status of maintenance and services for plant equipment at construction site monitored by specialists and related personnel at their local places, while taking necessary actions at the earliest opportunity. In particular, when the decision of the top management is required, real-time image can be transmitted from the site to the management meeting, etc.

5-5 Network Management System

(1) Overview

A network control system called SNMS (Satellite Network Management System) is installed in the TS-NET and plays 2 principal roles. One is to control networks mainly for the purpose of remote monitoring and control of satellite earth stations. The other role is to centrally control and administrate service equipment and apparatus for multipoint-station videoconferencing, remote education, image transmission, etc. The system configuration of SNMS is shown in Figure 8.

The SNMS considers of SNMS-M installed in the satellite communications monitoring center in the head office and SNMS-S installed in the transmission stations in each works. The SNMS-M and SNMS-S are connected through the Toshiba group VAN (TG-VAN) and communicate various information requested to operate the TS-NET. The SNMS-S is connected to the earth station equipment and each operation console provided in videoconferencing room, remote education classroom and studio in the transmission station in a works. It communicates line control signal and alarms signals, etc. with the earth station equipment while giving and receiving operation signal and screen control signals, etc. with each operation console.

(2) Functions

[SNMS-M]

- Operation control function: Covers the beginning operation and stop control of the network control system and the operation control of satellite communications system.
- Failure management function: Centrally monitors failures in the satellite network.
- Schedule management function: Registers the type and beginning and ending time of the service while automatically executing it.
- Maintenance function: Can initially or again begin and stop the SNMS-M and indicate the operation record

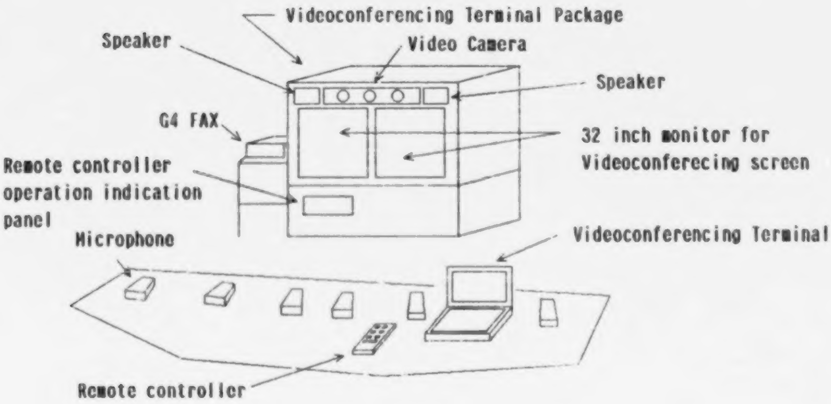
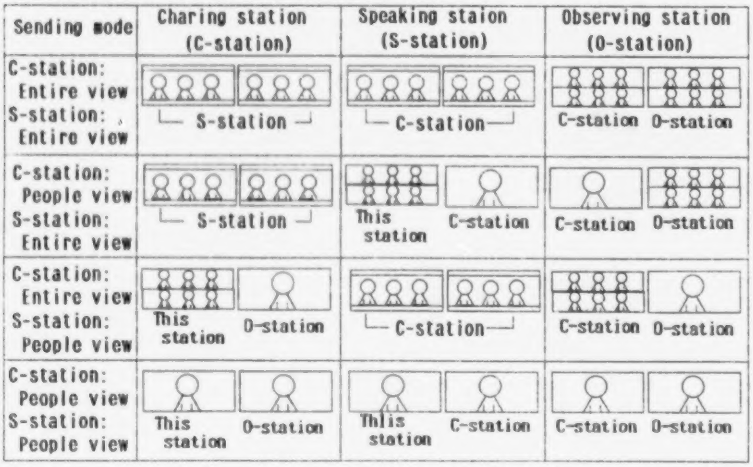

Videoconferencing Terminal Package
Speaker
Video Camera
Speaker
G4 FAX
32 inch monitor for Videoconferecing screen
Remote controller operation indication panel
Microphone
Videoconferencing Terminal
Remote controller

Figure 4. The general view of videoconferencing room

Monitor display: When this station is OFF



Sending mode	Charing station (C-station)	Speaking staion (S-station)	Observing station (O-station)
C-station: Entire view S-station: Entire view	S-station	C-station	C-station O-station
C-station: People view S-station: Entire view	S-station	This station C-station	C-station O-station
C-station: Entire view S-station: People view	This station O-station	C-station	C-station O-station
C-station: People view S-station: People view	This station O-station	This station C-station	C-station O-station

Figure 5. Monitor screen displays examples of monitor screens in the packege type

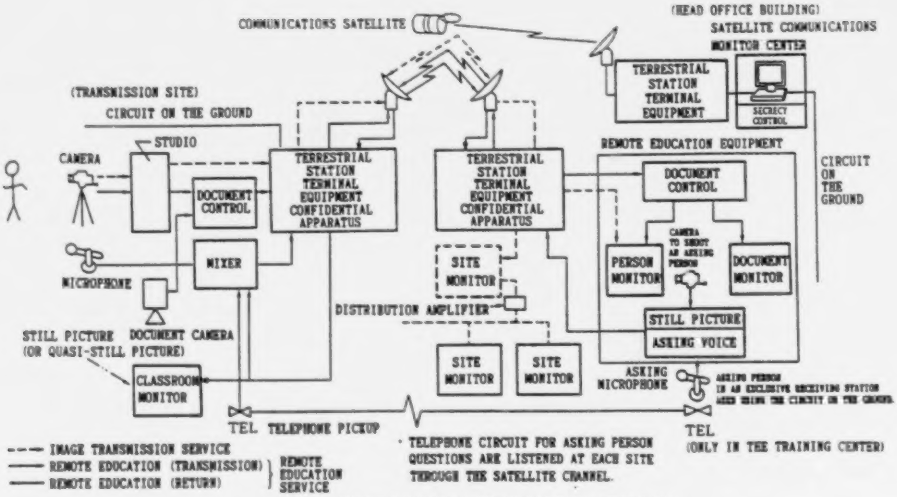
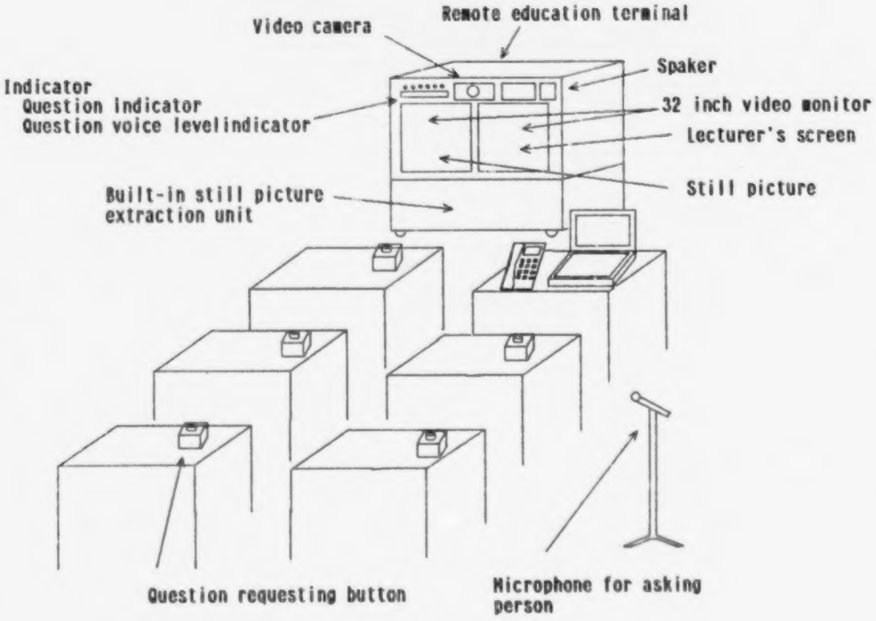

COMMUNICATIONS SATELLITE
(HEAD OFFICE BUILDING)
SATELLITE COMMUNICATIONS
MONITOR CENTER
TERRESTRIAL STATION TERMINAL EQUIPMENT
SECRECY CONTROL
(TRANSMISSION SITE)
CIRCUIT ON THE GROUND
STUDIO
CAMERA
DOCUMENT CONTROL
TERRESTRIAL STATION TERMINAL EQUIPMENT CONFIDENTIAL APPARATUS
TERRESTRIAL STATION TERMINAL EQUIPMENT CONFIDENTIAL APPARATUS
REMOTE EDUCATION EQUIPMENT
DOCUMENT CONTROL
CIRCUIT ON THE GROUND
MIXER
MICROPHONE
DOCUMENT CAMERA
SITE MONITOR
CAMERA TO SHOOT AN ASKING PERSON
PERSON MONITOR
DOCUMENT MONITOR
DISTRIBUTION AMPLIFIER
STILL PICTURE
ASKING VOICE
STILL PICTURE (OR QUASI-STILL PICTURE)
CLASSROOM MONITOR
SITE MONITOR
SITE MONITOR
ASKING MICROPHONE
ASKING PERSON IN AN EXCLUSIVE RECEIVING STATION ASKS USING THE CIRCUIT ON THE GROUND.
TEL
TELEPHONE PICKUP
TEL
(ONLY IN THE TRAINING CENTER)
TELEPHONE CIRCUIT FOR ASKING PERSON QUESTIONS ARE LISTENED AT EACH SITE THROUGH THE SATELLITE CHANNEL.
IMAGE TRANSMISSION SERVICE
REMOTE EDUCATION (TRANSMISSION)
REMOTE EDUCATION (RETURN)
REMOTE EDUCATION SERVICE

FIG.6 SYSTEM CHART FOR BROADCAST SERVICE

Figure 7 Genral view of remote cducation classroom
(2-way classroom)


Video camera
Remote education terminal
Spaker
Indicator
Question indicator
Question voice levelindicator
32 inch video monitor
Lecturer's screen
Still picture
Built-in still picture extraction unit
Question requesting button
Microphone for asking person

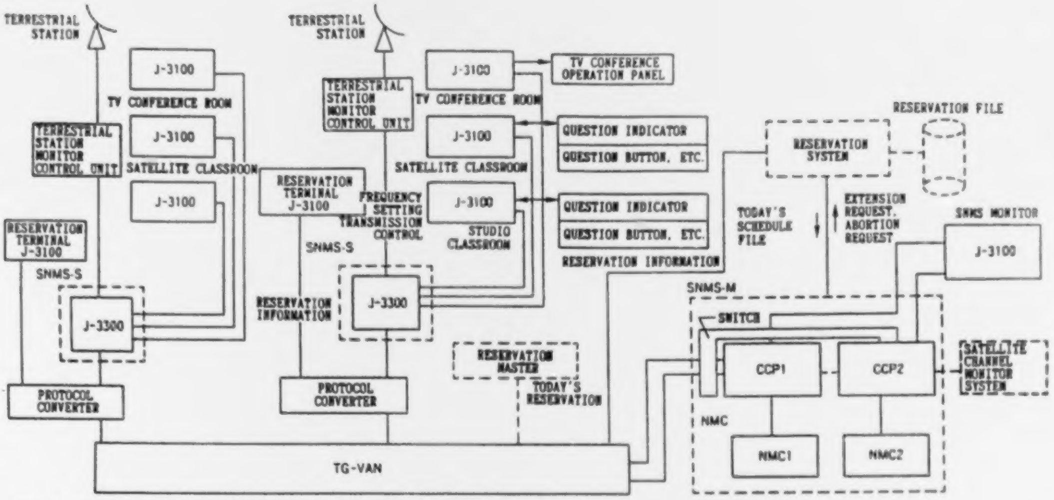

TERRESTRIAL STATION
J-3100
TV CONFERENCE ROOM
TERRESTRIAL STATION MONITOR CONTROL UNIT
J-3100
SATELLITE CLASSROOM
J-3100
RESERVATION TERMINAL J-3100
SNMS-S
J-3300
PROTOCOL CONVERTER
TERRESTRIAL STATION
TERRESTRIAL STATION MONITOR CONTROL UNIT
RESERVATION TERMINAL J-3100
FREQUENCY SETTING TRANSMISSION CONTROL
SNMS-S
RESERVATION INFORMATION
J-3300
PROTOCOL CONVERTER
J-3100
TV CONFERENCE ROOM
J-3100
SATELLITE CLASSROOM
J-3100
STUDIO CLASSROOM
TV CONFERENCE OPERATION PANEL
QUESTION INDICATOR
QUESTION BUTTON, ETC.
QUESTION INDICATOR
QUESTION BUTTON, ETC.
RESERVATION INFORMATION
RESERVATION MASTER
TODAY'S RESERVATION
TG-VAN
RESERVATION SYSTEM
RESERVATION FILE
TODAY'S SCHEDULE FILE
EXTENSION REQUEST, ABORTION REQUEST
SNMS MONITOR
J-3100
SNMS-M
SWITCH
CCP1
CCP2
SATELLITE CHANNEL MONITOR SYSTEM
NMC
NMC1
NMC2

FIG. 8 SYSTEM CONFIGURATION OF SNMS CONTROLS THE SATELLITE COMMUNICATIONS SERVICES AND MONITORS OPERATION STATUS AND FAILURE CONDITIONS, ETC.

[SNMS-S]

- Operation management function: Control to begin and end the services such as image transmission, remote education and videoconferencing and the status of the modem.
- Failure management function: Displays information on failures occurring in the earth station equipment administrated by the SNMS-S and SNMS control system communications channels, on the screen while informing the SNMS-M of the failures.
- Maintenance function: Can stop the operation of the SNMS-S, test the modem and collect and indicate failure records of earth stations.

6. Effects of TS-NET Introduction

Using the TS-NET, space and time for communications can be made shorter. Much more effects will certainly result by strategically utilizing acquired information of "in-time", "voluminous image traffic" and "uniformly broadcasting nature."

(1) Expansion of education and training opportunities

Various educations and training are offered to all people no matter where they are, while not worrying about transportation time and cost and traveling cost. Thereby, the system is quite effective to enhance the capabilities of the employees.

(2) Quick transmission of information

- Information on product and services can be transmitted quickly to all salesmen and serviceman despite much increasing high-tech products and newly released articles. Thus, levels of services offered to clients have been increased more than competitors.
- Instructions from the top management can be notified to all works and offices quickly, while promptly and precisely collecting reports from local offices though videoconferencing, etc.

(3) Uniformity of information

Many people distributed in a wide area can receive voluminous "image plus voice" information without attenuation through the presentation.

7. Problems

Among applications, the remote education shares a majority while not satisfactorily applying to sales purposes for the markets. The reasons why the system has been applied more to education include that in-house education of Toshiba had been introduced and operated before the application to the TS-NET, that lecturers, manuals and texts are already prepared, that new texts can be easily prepared and that the lectures are skilled in working with the system. In other words, many education programs have been transferred from conventional education systems directly to the satellite communications systems while while not making the most of image utilization technology.

User departments are rather deviated to limited staff departments and offices. Departments where the system is not operated often "hate the system without actually trying it" perhaps because of hating or fearing cameras.

8. Future orientation

The following applications of the TS-NET will be pursued.

(1)The number of exclusive receiving stations (TVRO) will be increased to consumers appliance selling companies and other related organizations, thereby expanding and diversifying remote education services.

(2)The size of each videoconferencing station will be made smaller to reduced videoconferencing introduction cost to popularize the satellite multipoint-station videoconferencing.

(3)Using the INTELSAT satellite, a global network with overseas offices and works will be constructed.

Satellite communication services to be introduced in the future will include multilateral services using low-speed data and high- precision still pictures, etc. by means of the portable VSAT or TVRO in addition to the current moving picture transmission systems. In addition, earth stations for these systems will be smaller in size and lower in cost because larger communications satellite will be introduced, thus encouraging the demand.

Furthermore, mobile satellite communications services will be practically introduced, though they are presently tested with automobiles and airplanes. In addition, navigation and communications composite system using 2 or more satellites will also become more popular.

9. Conclusion

The TS-NET plays a major role of communications infrastructure for Toshiba as introduced in the above. The performance and functions of the system will be positively improved while looking for new applications of satellite communications.

(Reference Literatures)

1. Katsuhiko Kimura, et al.:Toshiba in-house satellite communications systems, Toshiba Review, 45, 2,pp141-144 (1990)

2. Kazuo Noda, et al.:Satellite communications Networks Control System, Toshiba Review, 45, 9,pp702-705(1990)

3. Toshiba Training Center: '90 OA Award,Secondary Examination Application "Satellite Communications Systems (TS-NET) with particular emphasis on satellite education"

Telecommuting Centers: Past, Present, and Prologue To Another Future

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Santa Monica, CA 90405 USA

Business is discovering that telecommuting isn't just home-work, anymore. Corporations around the world are experimenting with innovative forms of "telecommuting centers", reaching beyond early experience and research with work-at-home, and challenging the structure, the technology, the work and the people of the contemporary office within a global environment.

Telecommuting is working at a remote location and communicating with a central workplace by electronic means, instead of moving the people to the office.

We hear and read a lot, today, about how telecommuting is a truly marvelous idea: "an idea whose time has finally come." Employees love it, communities love it, transportation departments love it, and so do air quality regulators, government agencies, telephone and computer companies.

At the same time, another question keeps coming up, in telecommunications conferences and in working sessions where people are trying to establish telecommuting programs. The question is this: if telecommuting IS such a great idea, why have we had such a hard time persuading BUSINESS to implement it?

The answer to that question has three parts:

First, telecommuting has been promoted to employees -- the wrong market. Second, telecommuting has been promoted for its air quality, traffic congestion, and community benefits - the wrong reasons. Third, telecommuting has been sold as work-at-home -- the wrong product.

These are the same mistakes that micro-computer vendors made in the 1970s when they tried to persuade families to buy personal computers to handle recipes and other home management tasks.

1. Telecommuting and Business

Telecommuting, in a business context, offers major and unique opportunities to bring together:

NEW PRODUCTS to meet changing CLIENT NEEDS,

OFFICE DESIGN that is responsive to SERVICE SECTOR REQUIREMENTS,

TECHNOLOGY to support GROWTH MANAGEMENT STRATEGIES, and

INFORMATION SERVICES for a GLOBAL ECONOMY reaching far into the 21st century.

To take advantage of these business opportunities, we need to adopt a more realistic approach to telecommuting and to heed the lessons learned from early telecommuting programs and research.

First, we need to learn both the good news and the bad news about our experience with early telecommuting programs.

Second, we need to develop forms of telecommuting that are responsive to the current and future needs of information-oriented businesses.

2. The Good and The Bad

The reality of home-based telecommuting is that many of the early work-at-home pilot programs are no longer in existence. Others have been sharply reduced in size.

Innovative work-at-home programs, including those of New York Telephone, Control Data, and the Federal Reserve Bank of Atlanta, were discontinued due to the departure of their "champion". Programs such as Fort Collins and the Southern California Association of Governments experienced significant drop-off in participation. IBM, Hewlett-Packard, and Apple have re-examined their programs and describe them, today, more accurately as "overtime" work-at-home, "flexible work schedules", or in-house use of the corporate network and electronic mail system.

Telecommuting affinity groups, such as the Association of Home-Based Businesses, the Association of Electronic Cottagers, among others, are no longer in operation. Organizers of these groups believe that the short active life of telecommuting associations is inevitable, since the membership is interested primarily in how to get started as an individual worker. They are not interested in the long term implications of telecommuting from the business perspective.

If sale of telecommuting to employees has a short "product life", then sale of telecommuting to public agencies during periods of gas shortages, air quality concerns, disaster recovery, or disability awareness promotes an attitude that telecommuting is just another temporary political issues.

This is supported by the rise and fall of interest in work-at-home telecommuting in tandem with these *topical concerns and fluctuations in the economy.* The same pattern will hold true with telecommuting programs that rely exclusively on a foundation of congestion management or emergency preparedness. Approaches which encourage and emphasize the least-cost or marginal telecommuting solutions can just as easily go away when the political priorities change.

Finally, the most important lesson to be learned from past experience with telecommuting programs is to acknowledge, accept, and respond to the very specific concerns that business has raised about work-at-home telecommuting.

Business has objected to work-at-home for the following reasons: the ban by the service workers' union; use of the employees' private space without compensation; the high cost of individualized telecommunication lines and equipment; reduced opportunities for employee career-pathing and professional synergy; individual needs for office documents and support services, supplies, and equipment; uncompensated improvements in employee productivity; questions about security of remote data, and the costs and complexity of remote computer/network support.

Advocates of work-at-home telecommuting respond that these problems can be overcome by (1) selecting the best workers, (2) training them, and (3) being supportive as they encounter problems. Business has not been convinced that these "solutions" are adequate to the task. So, in the absence of acceptable resolution to objections about work-at-home, business has begun to look elsewhere for solutions.

3. Keys to Business Survival

If telecommuting is to thrive in a global and information-oriented economy, then it will do so by building on those factors that contribute to successful telecommuting programs within a business framework.

First, business wants to see that other business people have tried telecommuting and succeeded because of it.

Second, business wants to know the circumstances that prompted other companies to implement telecommuting. They want to match their business characteristics up against others with the same or similar experiences.

Third, business wants to know what does it take to implement a telecommuting program to meet those needs.

Fourth, business wants to know the risks they face: the potential loss or exposure and the probability that the project might fail.

4. Corporate Experience

Some major, successful telecommuting programs are those that involve satellite or local work centers, rather than exclusively work-at-home. These programs required that business assess their information and communication needs within the overall organization, develop an implementation strategy to integrate telecommuting into the mainstream of operations, and support telecommuting along with other business activities in their contribution to profitability and productivity.

4.1 Rockwell International: Short-Term Projects

In 1982, Rockwell International (an aerospace design and manufacturing firm headquartered in Newport Beach, CA) established a satellite office in San Diego, CA for its Semi-Conductor Design Division. Called The Design Center, it was a remote office set up 80 miles to the south of Rockwell's headquarters.

The motivation behind The Design Center was to deal with a unique shortage of labor situation. The aerospace firm had purchased a San Diego-based advanced design engineering firm. However, specialist employees of the newly-acquired design firm refused to relocate to Newport Beach. A year after establishing the satellite office in leased space, about 20 design engineers worked there, daily, using phone lines and electronic mail to communicate with the rest of the project management based in Newport Beach. Once a month, both groups would gather in Newport Beach for update presentations and project review meetings.

Rockwell disbanded The Design Center in 1987, but established other decentralized local work facilities for 100 to 120 person project teams in offices that they owned in the high-technology labor pool areas of Newbury Park and Santa Barbara, CA.

4.2 The Travelers': Office Cost Savings

The Travelers' Insurance Company started a remote office telecommuting program in 1982, using contract programming facilities outside of its Hartford, CT headquarters.

The Travelers' motivation came from potential savings in office space, shortages of labor in skilled categories, and opportunities to use computer resources off-hours The lead reason was the need to accommodate the fluctuating space requirements of its Data Processing Department staff.

The telecommuting program became a formal project in 1986, covering many more employment categories of the insurance services firm. The Travelers' provided equipment, furniture, software, voice-mail, and electronic mail. The program was voluntary, with no differences in benefits, salaries, or career paths for telecommuters compared to other office workers.

A major innovation of The Travelers' program was their recognition that at-home and group-office workers had unique needs in the area of technology support and services. They developed their own

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selection and training procedures to deal with these issues.

By 1987, The Travelers' had a total of 6 remote data processing facilities in operation for full-time and part-time employees: 4 were in Connecticut, 1 in New Jersey, and 1 in Ireland.

4.3 J.C. Penney: Market Coverage

A somewhat different approach was taken by retailer J.C. Penney Company when it linked workers-at-home with a satellite catalog order center. Their approach combined a communications hub with automatic call distribution (ACD) equipment to switch calls through order centers to at-home workers who processed the orders using company-provided terminals and communication lines.

The program began in 1986 with 3 catalog order centers through which it routed telephone orders, originating nationwide, to 6 part-time sales takers located in home offices. The catalog sales centers were expanded in several phases: first, in early 1987, to 4 sites with 24 at-home workers; later in the same year to 6 sites with 126 employees; and finally in 1988, to 8 sites with 206 employees in 5 states.

4.4 Trans World Airlines: Peak Period Work Force

Trans World Airlines contracted with the State of California Free Venture Program to train "cloistered labor" as short-notice ticket reservation agents. The Ventura School site of the California Youth Authority housed youth offenders in a minimum security facility. The training and the reservations center were a dedicated part of the facility in Camarillo, CA. The Ventura School was considered a remote site connected to the Los Angeles reservation center.

The wards at the Ventura School used dumb terminals connected to TWA's reservation system. They received calls for reservations and ticketing through the same automated call routing system used by other TWA reservation centers. TWA established the program to be able to have agents on call within 1/2 hour, to respond to peak period travel call demand.

A similar program is now being established with the Chino, California Training School to contract for youthful offenders to serve as hotline referral agents. Clients would call the agents and request the name and location of vendors of smog control devices approved by the State Department of Consumer Affairs and CALTRANS. (Other similar programs can be expected now that California voters approved a state proposition in November 1990 authorizing business to contract for "cloistered labor".)

4.5 Pacific Bell: New Product Marketing

Pacific Bell started shifting employees into remote office locations as part of a strategy to help re-distribute traffic during the 1984 Los Angeles Olympics. Two satellite offices were set up. One was in San Francisco, using space in the 5th floor of the former headquarter offices, after the firm relocated the bulk of its staff to San Ramon in the East Bay area). The other was located in Woodland Hills (outside of Los Angeles) and later relocated to North Hollywood. Both offered shared-office cubicles for use by 15 to 18 Pacific Bell employees. The satellite offices were equipped with voice communications and a local area network giving access to normal Pacific Bell central office data processing resources.

Pacific Bell formalized their telecommuting programs for management workers in 1985. Today, Pacific Bell is aggressively marketing their telecommuting program to public agencies as part of an effort to introduce other telecommunications services and products.

4.6 United HealthCare: Turnover/Productivity

United HealthCare Corporation (UHC) processed health claims for clients in 14 states including Minnesota. In January 1986, as part of an effort to consolidate claims processing in the Twin Cities area, UHC decided to establish a remote claims processing center employing 15 workers in the small town of International Falls in Northern Minnesota.

The 8,000 population town offered UHC some things that the company just could not find in the "big cities" of Minneapolis/St. Paul: a stable employment base of workers. In the highly competitive headquarters labor market area of the Twin Cities, the average turnover of employees was about 30%. In International Falls, turnover was less than 7%.

UHC measured worker productivity at the remote facility and found those claims processors were a minimum of 10% more productive per person than their headquarters counterparts and an average of 20% more productive overall.

They found the smaller town employment pool was not specifically trained to handle claims processing, but that they were responsive to education in general. So, the company designed and provided a complete training program covering basics to advanced aspects of the health industry claims processing requirements. UHC next teamed up with another willing partner, the local community college, to develop ongoing health care industry training to complement that provided by the company.

A year later, the second remote work center was opened in Hibbing in northeastern Minnesota. A third center was opened in Duluth the following year. Today, the remote office in International Falls employs about 120 workers, Hibbing another 48, while Duluth has 80 claims processors.

Each remote facility was connected to the Minnetonka or Twin Cities centralized claims processing centers, and to Health Plans in other states, by high speed digital communications, allowing each center to be online in real time to the central health care information bank.

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4.7 Lessons Learned

The circumstances that prompted these firms to implement telecommuting at work centers all relate directly to bottom-line business concerns: staffing for short-term projects, savings in office costs, enhanced geographic market coverage, peak period service response, new product marketing, reduced turnover and increased productivity.

5. Other Research Programs

At the same time that we learn from corporate success stories, we also have information and innovation from more limited pilot programs and from focused research projects that examined a particular facet of telecommuting at work centers.

5.1 Multi-Service Centers: Efficient Service Delivery

In 1973, the Los Angeles-based architectural and planning firm of Victor Gruen Associates designed a "remote work center network" consisting of 44 facilities located throughout the State of Maryland, re-distributing services that formerly had been dispersed among 448 separate and independent federal, state, and municipal office locations.

The project was to provide the public with one-stop service delivery of all governmental agency services, using facilities that were scaled in size to respond to an hierarchy of needs associated with the surrounding community service area. It included the design of a prototypical center to show how multiple levels of government could be located in non-conflicting work-relationships.

5.2 Nykvarn: Worker/Services Synergy

In 1982, the Nordic Institute for Studies in Urban and Regional Planning (NORDPLAN) conducted a remote, multi-company telecommuting work center experiment, Neighborhood 90, located in the City of Nykvarn, about 30 miles outside of Stockholm.

The project evaluated how business and public sector employees worked together at remote work locations, especially to provide mutual support for use of the center's technology and to assess the need for other support services.

5.3 Hawaii Telecommuting Center: Online Information Access

A more recent multi-company telecommuting center project was the State of Hawaii demonstration project, involving public agencies and private companies in shared-tenant offices located in the Mililani Technology Park.

The project also identified innovative ways that tenants could use telecommunications to move information electronically from online government libraries and storage in downtown Honolulu.

5.4 Japan Satellite Centers: Workplace Redesign

In Japan, in 1985, a research group led by the Sumitomo Trust & Banking Company began evaluating alternative forms of telecommuting. They established a small satellite work center on the 4th floor of a 5-story office building located in the residential community of Shiki, about 50 km. northwest of Tokyo. The center was used on a part-time basis by public and private enterprise workers from firms based in Tokyo.

The project focused on how to establish an environment that encouraged worker creativity and productivity.

5.5 Japan Resort Offices: National Decentralization

A different research group in Japan established a complementary satellite office program as part of a nation-wide decentralization effort. They focused on creating "resort offices", locating office workers close to country club or ski resorts as part of an effort to entice skilled, specialized labor to outlying employment opportunities.

The project deployed manpower into rural districts in order to help revitalize local industries and to reduce urban growth pressures on Tokyo. The resort offices project also tried to provide more humane, creative working conditions for professional "salarymen".

5.6 Lessons Learned

These efforts demonstrate other valuable products and services that may evolve from telecommuting center development: more efficient service delivery and infrastructure, enhanced worker synergy and collaboration, improved access to information resources through electronic delivery methods, enhancements to worker creativity and productivity, redesign of the workplace out of the urban center, and rural economic development.

6. Technology-Enhanced Facilities

These are the well-know corporate programs and research undertakings in the field of telecommuting at work centers. In addition, we also find major business investment and interest in projects that are outside of the strict definition of "telecommuting". These actually share many of the same fundamental objectives and features of telecommuting centers.

These projects demonstrate that business is experimenting with many possible solutions, testing different aspects of how they can move information to the office rather than moving the people. We summarize them under four broad categories:

1. technology shells
2. executive office suites

3. travel-oriented facilities
4. unbundled services.

At the present time, no one product or area is dominant. Taken together, they paint a broad picture of future trends in the field of telecommuting or, more accurately, **telework**: the provision of innovative products, services, and facilities to support global, information-oriented business activities.

6.1 Technology Shells

Technology shells are office parks or buildings ready to receive and to support high-technology equipment and tenants. Technology shells package and deliver, to a given property, high speed, long distance telecommunications services from telephone companies, video conference firms, security equipment vendors, and computer hardware and network providers.

6.1.1 Office Sites

The most familiar example within this category is the teleport, with facilities for satellite uplink and downlink on-site.

Another example is the GTE SmartPark$_{\mathrm{sm}}$: planned office developments with fiber-optic cabling to the site and switching facilities on-site.

Other technology shells may be called: technology parks, research parks, and university-related research parks. The latter group of properties may only have access to fiber-optics at the site periphery or to high-technology employment and technology transfer at nearby university facilities.

The American research universities and centers have the near-ubiquitous, nationwide, high-speed communications network in INTERNET, BITNET, and NSFnet: "superhighways for electronic messaging".

Internationally, the Japanese experiment with technology shells takes the form of the technopolis (also called the "multi-function polis"). Development of these contemporary "new cities" is occurring in Japan, itself, and elsewhere in the Pacific and Australian markets. These projects are an attempt to reconstitute "new communities" into "information centers" or "science cities", very much like large-scale technology parks.

6.1.2 Office Buildings

Intelligent buildings (or "smart offices") are technology shells at the scale of the individual office unit. The concept of "smart buildings" thrived in the years immediately after the break-up of AT & T. However, vendors and projects suffered serious damage to their reputations because of the overzealous sale of "shared tenant telephone services", poor product quality and marginal management.

Today, intelligent building design, in the U.S. marketplace, is more limited to the building's mechanical and electrical components. These include: (1) small zone heating, lighting, air conditioning, and security, (2) automatic billing for these services to tenants, and (3) single sleeve cabling for multiple wiring systems that can be pre-laid throughout the building.

The Japanese commercial office market has taken a lead in recent efforts to develop intelligent buildings that combine high quality, environmentally sensitive structural design with contemporary building and tenant digital electronic services.

An example of the state-of-the-art in this design area is the NEC Headquarters Super Tower located in Tokyo. The Super Tower combines innovations in structural and environmental design with an "advance total office automation system" to provide a wide array of office support electronic services to all employees within the building.

6.1.3 Residential Units

An extension of building intelligence is the intelligent home (also called the "smart house"). The U.S. marketplace is testing a generic approach to intelligent homes, consisting of home wiring systems and microprocessor chips or sensors in the building structure and in the home appliances to handle security, voice-activated control of lights, VCRs, and other automated home appliances and equipment.

About 100 North American firms are working with the National Home Builders Association's Smart House project to prototype a network of streamlined cable-wiring that will support a wide variety of existing electronic products oriented to the home technology market.

Japanese and European electronic systems integrators and component manufacturers are trying to devise a competing, but "open architecture" version of home-automation; a concept that can be adapted to future technology.

6.2 Executive Office Suites

Executive office suites are enhanced technology office shells that serve small businesses and independent entrepreneurs. Suites, today, deliver "Fortune 500" calibre business support services, computer networks, hardware, and software to the basic unit of small business office space.

6.2.1 Regional Suites

Executive office suites exist in every metropolitan market, and often serve a specific office submarket (e.g., regional sales personnel). Elsewhere, they are used to fill newly-constructed office space with temporary tenants or "business incubator" tenants that are willing to accept short-term leases until the market area can mature and support larger, longer-term tenants.

Examples of sales and marketing regional suites include the O'Neill Development Executive Suites and OmniOffices, both of which serve the southeast U.S. area. They provide offices and "Fortune-500" support services for regional marketing representatives of national firms.

6.2.2 Niche Suites

Niche suites are executive suites that have their technical support services "tuned" to the needs of a sub-market with special information requirements.

Fegen Suites is a chain of executive office suites oriented exclusively to the needs of the legal profession. Most of these offices also have dedicated modem access to online legal abstract services such as LEXIS or news databases such as NEXIS.

Office Technology Group has established two stand-alone Comm Centers for independent small business entrepreneurs. Comm Centers use an AT & T mini computer-based LAN to provide shared, support services so that start-up businesses can avoid the capital investment required to have a basic system, including hardware, software, and trained support personnel.

One Comm Center is located in Hillsdale, outside of San Francisco; the other is in Ontario, between Los Angeles and San Berndardino. A third Comm Center recently opened on one floor of the Long Beach World Trade Center.

6.2.3 International Suites

International suites are designed to provide the start-up overseas business enterprise with all the support equipment, personnel, and services, including electronic communications and videoconferencing capabilities to the base office headquarters.

HQ Network Systems, with offices in 93 cities, is among the largest executive office suite management firms. One HQ affiliate, Intelligent Building Services of San Diego, has a joint venture agreement with Americom International Corporation to manage The Americom Business Center (the first executive office suite in the U.S.S.R.)

6.3 Travel-Oriented Technology

Travel-oriented technology consists of products or facilities to support the business travel market, whether among cities or intra-city (providing alternatives to commuting or a reformulation of the traditional business meeting).

One facet of the travel-oriented business provides goods and services to "move the office with you when you travel", while the other lets business people "stay at the office, but move your image and information."

6.3.1 Mobile Office

The "move the office" approach is for highly mobile clients in niche markets, primarily executive traveler services. Typically, providers charge premium fees or deliver abbreviated equipment or services.

Examples in this market category include: airport and hotel executive centers, all suites hotels, and express ticketing networks. They are business activities that relocate the office functions, including support telecommunications and computing services, to the hotel/resort or the airport. Hotels, conference facilities, and rental car dealers now offer clients the opportunity to rent fax equipment, portable or laptop computers along with other office-support services.

6.3.2 Mobile Information

The "stay at the office, move your information" approach includes facilities or services that eliminate the need to travel, whether across the nation or across town.

Examples are "public video conference rooms", provided by companies such as Conference Express, a joint venture of U.S. Sprint Communications and Olympia & York. Public video rooms offer business a location and support equipment to downlink training sessions, regional sales meetings, executive briefings, or project planning sessions. Major providers offer these facilities and services internationally.

Other firms, such as ComputerLand (with franchises throughout the nation) or The Inland Atrium (a local videoconference facility in Ontario, CA) rent their private video rooms on an hourly basis in major cities such as Los Angeles, New York, San Francisco, Chicago, and Toronto.

Privately-owned corporate video rooms (or "business TV") are among the fastest growing sectors of the video-conference marketplace, with a forecast of over 80,000 private, corporate TV sites nationwide by 1992.

Today, even conventions are being video-taped, with excerpts broadcast on major cable networks, obviating the need for business people to travel to trade shows or to other major public gatherings.

6.3.3 Mobile Meetings

Another developing area involves collaborative meeting labs (or "electronic meeting rooms", currently in the research and development stage at a few major universities. Collaborative or electronic meeting rooms are large conference rooms with computer terminals for each attendee. Terminals are networked together and to a "public screen" area. Software captures the electronic notes or messages from each workstation, then manipulates, manages and re-displays the information on the shared, large wall screen.

Firms such as Arthur Andersen & Company, Steelcase

Inc., Xerox PARC, IBM, DEC, Apple, and Electronic Data Services (EDS) are designing and developing high technology collaborative labs to help corporations and public agencies conduct more productive, focused, and cost-effective meetings, especially when they depend upon the interaction of specialized disciplines (within their firm or among business entities) trying to work together as project teams.

6.4 Unbundled Services

Unbundled contract services (or "outsourcing") have evolved as business has spun off specific corporate services to third-party providers. Corporations then contract those services back for a fixed term and price. Outsourcing is a natural consequence of business' down-sizing and concentrating on core activities.

6.4.1 Information Service Support

Outsource service providers also are known as facilities managers (for example, when they operate data processing centers for another firm) or network managers (when they are take over responsibility for all telecommunications and computer network management functions).

Other firms subcontract micro-computer support services, software maintenance programming, or other data processing support services to outsource specialists such as IBM, Businessland or EDS.

6.4.2 Disaster Recovery

A major field for outsourcing is disaster recovery (or contingency planning facilities). Telehouse Center, for example, is a $35 million, 162,000 square foot building (located next to the New York Teleport on Staten Island) dedicated to contingency planning. Telehouse Center is a joint venture of AT & T and 21 Japanese telecommunications suppliers and banking/securities company users. Tenants rent space and services to ensure they have computer backup facilities and services on very short notice.

Recruit USA has two disaster recovery facilities in the U.S. to support the high technology backup and contingency needs of Japanese banks with New York offices. These are the Recruit Newport Center and the Recruit Staten Island Teleport Facility.

Nippon Telephone & Telegraph has a U.S. subsidiary, NTT Data USA, which has leased the top 4 floors of a Jersey City office tower from which they provide facilities management, systems integration, software and network management for Japanese clients with U.S. branch offices.

6.4.3 Small Business Services

In some cases, outsourcing involves the creation of net new smaller, more flexible, and more responsive independent business units. This has been a common practice in accounting, secretarial/typing, recruiting, security, building maintenance, cleaning, and catering professions.

On this smaller, creative end of the spectrum, we now find that architectural and engineering firms are spinning off their in-house drafting units as separate profit centers or subsidiaries, authorized to subcontract work from other competing firms.

Municipal and local governments also farm out their parking enforcement and management business to private sector firms.

Outsourcing is also a familiar practice among banks that subcontract all or a portion of their credit card transaction processing or trust accounting to third party providers.

7. Future Trends to Watch

Business is not avoiding telecommuting: it is experimenting with different strategies for "moving information, not people" as a way of responding to bottom-line issues.

7.1 Telecommuting Centers

Business is beginning to discover that "telecommuting isn't just work-at-home, anymore". Business interests are finding the concept of **telecommuting centers** a viable alternative that provides more flexibility and more solutions to today's business challenges.

A **telecommuting center** is a multi-company, shared-office facility, located close to residential labor markets. It is connected electronically to other more central offices, enabling employees to "move the business' information" rather than travel to distant and more expensive office locations.

As such, telecommuting centers offer the opportunity to pull together some of the threads that have come untied in the changing work environment.

Telecommuting centers encourages a redesign of the physical and the environmental work habitat that supports service sector communications, knowledge industry productivity and information worker well-being.

Telecommuting centers are distinct from satellite centers of one company. They represent a multi-discipline approach to "moving information not people". They offer economies of scale by sharing the costs of support technology and service over a larger tenant base. They provide cost savings in the form of lower office rental and parking costs at outlying locations. They can be closer to residential areas and local bus service, thus encouraging the use of lower cost modes of travel.

The design of telecommuting centers can promote their successful operation. Unlike stand-alone facilities, telecommuting centers can develop opportunities for professional and support service synergy through tenant selection and location.

Telecommuting centers also preserve the privacy and security of each tenant firm, much like independent enterprises in a shopping centers. Individual businesses are able to establish their own direct relationships with their primary or parent organization, their people, their workflows, and the technology of their own business enterprise.

7.1.1 Proximity to residential and labor markets

Telecommuting centers integrate office developments into suburban residential labor markets. They create work opportunities in affordable housing developments. Telecommuting centers are an integral part of mixed-use developments scaled to the different scope of needs that are dispersed throughout neighborhood, community, and regional marketplaces.

Telecommuting centers provide direct access to local labor markets. At the same time, they provide firms with direct access to global training resources and the capability to electronically tap into specific knowledge expertise anywhere in the world.

7.1.2 Scaled to meet market area demands

Telecommuting centers exist at the **neighborhood scale**, providing clusters of local activities oriented to the family-scale of service needs and accessible in person. Services that are physically separated today, whether it be banking or post or day care information or video sales, can be merged together in more efficient, more cost-effective, but still personalized delivery services or facilities.

Telecommuting centers at the **community scale** create opportunities to import, electronically, information goods and services to serve the larger-scale demands of small and medium sized municipalities.

Telecommuting centers at the **regional scale** offer unique business-to-business services which support niche or specialized market demands, but also have the economic reach to help new, small businesses to thrive and to grow.

7.1.3 Hierarchy of connectivity

Rather than depend exclusively on expensive, private point-to-point communications, telecommuting centers tap into regional high-speed communication systems to connect large basins of communities. These regional system, in turn, connect to national and international communications backbone systems: information superhighways.

Centers create near-ubiquitous electronic purchase and payments systems, anytime-and-anywhere electronic messaging services, and the immediate delivery of large-scale information-based products such as "burst" video, software, or newspapers.

7.1.4 Innovation in the office environment

Telecommuting centers encourage business to reassess their outdated organizations and restructure work flows to accommodate a dramatically different scale of demand for products and services. Remote offices allow business to re-examine the components of the service business and re-tool activities so they can integrate information into the business' strategic objectives.

Businesses use telecommuting centers to serve new projects, to operate as fast-track response units, to function as emergency or contingency offices, or to target customer service or market areas.

Telecommuting centers motivate business to examine new and innovative ways to replace expensive, inefficient paper storage and retrieval with other more cost-effective alternatives. They offer opportunities for workers to access shared information from a variety of sources and professionals, nearby or around the world.

7.1.5 Diversity of public/community services

Public agencies have both new methods of service delivery and new sources of revenue through telecommuting centers. These include: health monitoring, automatic payments and deposits, community action networks, government databases, local community information and publications.

Educational services opportunities are: distance learning and tutoring; conferences by broadcast video, satellite, or video-conference services; nationwide academic and defense research communications; online electronic encyclopedias and publication resources.

The burgeoning non-profit business sector is a source of net new information and services to be provided through telecommuting centers: online information about community services; state and local workshops; arts, sciences, history or service databases; charitable events; public hearings, town halls, and other public convocations.

7.2 Where Next?

As long as business and government conclude that "work-at-home" is the only form of telecommuting extant, we will continue to miss out on the potential of **telework** to address the long-term cost, productivity, labor, and technology concerns of the sophisticated and complex organization.

Everywhere we look, we see "pieces" of telecommuting centers that exist and thrive in the international community. We need to build on this foundation, to extract lessons from their experience, and to construct solutions that afford us the opportunity to deal with the challenges of the 21st Century.

Selected References

Committee for Research and Urban Development Conditions Centered Around Satellite Offices. Research and Study Report on Dispersed Offices in Japan: Summary and Extract (Tokyo, Japan: October 1990)

Engstrom, M., H. Paavonen and B. Sahlberg. "Neighborhood '90: Tomorrow's Work in Today's Society. A Full-Scale Experiment in Sweden" (Swedish Council of Building Research, Stockholm, Sweden: 1986)

Engstrom, M., G. Erikkson, and R. Johanson. "Working Flexible Hours in Time and Space: The Extent and Structure of Remote Work, A Summary" (The Swedish Work Environment Fund and the Swedish Council for Building Research: 25 August 1989)

Gordon, Gil E., editor. Telecommuting Review: The Gordon Report (TeleSpan Publishing, Altadena, CA)

Gouin, Michelle D. and Thomas B. Cross. Intelligent Buildings: Strategies for Technology and Architecture (Dow Jones-Irwin: Homewood, IL, 1985)

Gruen Associates, Inc. State of Maryland Multi-Service Center Study: Summary Report (Maryland Department of State Planning, Annapolis, MD: December 1976)

Huws, Ursula, W. B. Korte and S. Robinson. Telework: Towards the Elusive Office (John B. Wiley & Sons, Chichester, England: 1990)

IC^2 Institute of The University of Texas at Austin. The Technopolis Phenomenon (IC^2 Institute, Austin, TX: May 1990)

Kraut, Robert E. "Telecommuting: The Trade-Offs of Home Work" (Journal of Communications, 39:3, pp. 19, 47: Summer 1989)

Kraut, Robert, Susan Dumais, and Susan Koch. "Computerization, Productivity, and Quality of Work Life" (Communications of the ACM, 32:2, pp. 220-238, February 1989)

Lowndes, J.C. "Joint Venture Installs Earth Stations for Shopping, Mall Teleconferencing [J.C. Penney Private Satellite Venture]" (Aviation Week & Space Technology, V. 124, pp. 57-58: April 21, 1986)

National Association of Homebuilders. "The Coming of Smart House: Builders Version [videocasette]" (Smart House, L.P., Upper Marlboro, MD: 1989)

National Land Agency. "An Outline of the Basic Development Plan for the National Capital Region: Summary and Extract" (Tokyo, Japan: 1986)

Noothoven van Goor, J.M. and G. Leftcoe, eds. Teleports in the Information Age (Elsevier Science Publishing Company, NY: 1987)

Perin, Constance. "The Moral Fabric of the Office: Organizational Habits vs. High-Tech Options for Work Schedule Flexibilities" (Sloan School of Management Working Paper No. 2011-88: May 1988)

Ramsower, Reagan Mays. Telecommuting: The Organizational and Behavior Effects of Working At Home (UMI Research Press, Ann Arbor, MI: 1985)

Shiki Satellite Research Group. "Shiki Satellite Office: Report Summary" (Tokyo, Japan: August 1989)

Shiki Satellite Research Group. "Shiki Satellite Office: A Review of the First Experimental Stage" (Tokyo, Japan: August 1989)

State of Hawaii Department of Transportation. "Hawaii Telework Center: A Public/Private Sector Joint Venture" (Mililani, Hawaii: no date)

Global Private Network in Operation and its Trend

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ABSTRACT

The globalization of various business activities of major Japanese corporations has been occuring very rapidly. This has resulted in a well organized telecommunication network established to manage the accurate and timely flow of information. Every customer has their own strategy, objectives, network configuration and project formation. A variety of relative trends have been studied.

1. BACKGROUND

Many Japanese corporations which have been using public telecommunication services such as PSTN, PSPN, etc. as their international telecommunication mediums, have tended to implement their own orivate networks recently.

1.1 INDUSTRIAL CHANGE OF ACTIVITY

The globalization of Japanese corporations has been accelerating since the mid 1980's, motivated by the increased value of the Yen and intensified trade conflicts with major trading partners. The U.S. is the most favored country to invest in, considering its market size, low risks and less stringent regulations. This trend is followed by investment in European and Asian countries. More than 50% of investments in Asian countries are by manufacturing sector, because of social maturity, wage disparity and industry policies of host countries.

Very rapid growth of overseas investment resulted in the rapid growth of international communication traffic. In the last 4 to 5 years, it has been observed that international traffic has increased by more than 40% for telephone use and more than 50% for facsimile use every year. Ther has been amazing growth in the use of high speed digital leased circuits (above 56 kbps), which has almost doubled year by year.

Furthermore, international data traffic is increasing according to the growth of trading and business transactions. On the other hand, telex traffic is decreasing, but most companies must continue to use the telex for the time being.

1.2 TECHNOLOGICAL ADVANCE

In daily communication, corporations are using various mediums, namely voice, facsimile, data and telex. The key for success is how they can integrate all these mediums into one high-volume traffic flow. A multi-medium time division multiplexer or packet swithching equipment is utilized to realize the integration. It should be noted that recently, some multiplexers have an adaptive routing function.

Another key technology for network implementation is voice digitization and compression. Although there are various methods of voice compression, no one system provides the advantages of both voice quality and required band-width. 32 kbps ADPCM is very popular as a voice compression system. However, as an international leased circuit is expensive, 16 kbps or 8 kbps is usually utilized.

From the viewpoint of a telecommunications carrier, naturally, optical fiber cables and digital transmission techniques are advantageous for reducing service costs and increasing service quality.

1.3 TELECOMMUNICATION MARKET OPENING

In some developed countries, the international telecommunication carrier business (basic service) is already competitive. In Japan, the international carriers' market was opened in 1987 and two new carriers named ITJ and IDC entered competition with KDD. They claimed they would offer communication services at rates 20% cheaper than those offered by KDD. This resulted in price reductions by KDD as well. Therefore, customers have been enjoying comfortable circumstances.

1.4 DEREGURATION FOR LEASED CIRCUIT USE

Leased circuit users are prohibited from reselling the circuit to the third party in principle, conforming to CCITT Recommendation D.1. However, they are generally allowed to share the circuit with their relevant companies under certain conditions based upon the government to government ubderstanding. For example, since November of last year, holding 10% capital of the relevant company allowes the users to share the leased circuit between the U.S. and Japan.

Moreover, it is very important to connect a leased circuit to PSTN (domestic) in order to implement a broad network economically. Interconnection between international leased circuit and domestic PSTN in the U.S. has been admitted and many Japanese corporations have enjoyed this advantage. In addition, the PSTN to leased circuit to PSTN connection between the U.S. and Japan has basically been allowed since November of last year.

1.5 INDUSTRIAL FASHION

According to a survey recently conducted by NTT, around one-third of the major Japanese corporations are already using leased circuits, at least in some part of their corporate networks.

At the moment, the financial sector is the obvious leader in constructing global private networks because this sector is becoming more and more information intensive. Their concern is not just limited to cost reductions, but includes higher capacity and more secure networks. Concerning other sectors like transportation and manufacturing, they are still behind the financial sector, but we are seeing very strong demand for the construction of global private networks.

We believe more than 50% of the major Japanese corporations will possess their own global private network by the end of 1992.

2. IMPLEMENTATION EXPERIENCE

We have participated in many projects for the implemenation of global private networks for various Japanese sectors as both a contractor and a consultant.

2.1 FINANCIAL SERVICES COMPANY

The implementation of this network was planned for the purpose of exchanging financial information globally.

We selected a 8 kbps voice compression system after careful investigation and a series of users' opinion tests, and also a packet switching technique for other non-voice mediums. The "packetized" information is allocated over voice traffic without occupying any extra channel in a multiplexer, this technology is called "interpolation". Each 56 kbps or 64 kbps band-width can accommodate 6 channels, regardless of the type of medium.

This company is conducting their operations in ten major cities including Tokyo, New York and London because they are by far the most important city centers. Therefore, we selected these three cities for communication hub centers concentrating traffic from nearby cities to economize the network cost. In addition, we introduced a triangle configuration connecting Tokyo, New York and London to secure the network in case of serious failure in any route. Considering that there is almost no overlap of trading hours among these three cities because of time differences, this triangle network actually provides twice as much capacity between two cities respectively.

This triangle hub network configuration is also characterized by its fully optical fiber cable arrangement, used because of the concern for the possible deterioration of voice quality caused by the delay in satellite communication. We also decided to diversify the two routes by utilizing a different combination of carriers.

2.2 TRANPORTATION SERVICES COMPANY

This network is a typical industry groups' network including each business partner as well as their own overseas branches. A characteristic of this network configuration is that it connects a Far-East network centered around the Tokyo hub and a North-American network which has two main hubs in New York and San Francisco. This configuration was chosen because they have relatively many transactions within these regions.

In this case, the customer selected 32 kbps voice compression system according to their strategy to provide the best quality services for their partners and customers, and to invite more business transactions.

This network system is also characterized by a multi-vendor environment. They use TDMs, PBXs, Facsimile Mail Systems (FMS), Telex Swithes and Host Computers all supplied by different vendors. Therefore, they pointed out that the system integration capability was most important in the implementation of this network.

2.3 MANUFACTURING COMPANY

This network was planned by customer to promote grobal CIM (Computer Integrated Manufacturing). Therefore, its major medium is data for CIM, while voice communication is an additional service. As an extreme example, some nodes provide only data and facsimile communications services.

A characteristic of this network is that most of nodes are located in small and medium cities because their factories in foreign countries are not in metropolitan areas. Therefore, the network configuration is simplified as much as possible for the purpose of easy control and management of remote nodes and circuits. As the maintenance cost of remote is higher, the above approach may be effective.

3. OPERATIONAL EXPERIENCE

After the commissioning of global private networks, we generally participate in network maintenabce support work.

3.1 CENTRALIZED NETWORK MANAGEMENT SYSTEM

In most cases, Japanese corporations hope to control their networks from their headquarters' sides. However, they don't have any control function which operates 24 hours a day, in general. Therefore, they entrust some agent with the global private network management.

We have undertaken to control and manage several global private networks on a 24 hour basis on behalf of customers. In order to execute this function, we have established a network management center which we control ourselves. The Network Management System installed in the center supervises all nodal equipment and transmission links and can afford to isolate a failure in the network.

3.2 LOCAL SYSTEM SUPPORT BY CUSTOMER ENGINEERS

Various equipment installed are usually supported by the vendors or the maintenance agents. However, in most case concerning networks, circuit failures occur more often than equipment failures, and difficulties may be rooted in the combination or interface between circuits and equipment. These are always serious problems for the customer, because they don't have any effective means to remedy the problem within themselves.

Therefore, we assigned some staff as customer engineers in the major cities of the world. They help the customer to isolate a failure and then negotiate with carriers when circuit failure is suspected. They have good experiences in network design and vast knowledge of network configuration. In addition, they can use Japanese when dealing with Japanese customers. So, they are welcomed by customers and can good relationships with them.

3.3 SYSTEM FAILURE CHARACTERISTICS

We took statistics on the system failure characteristics of a certain customer's network for six months from the date of commissioning. 110 cases of total failure occurred and we found only one case of equipment failure among them. That means that customers would require circuit isolation support not equipment maintenance support.

4. MATTERS TO BE ADDRESSED

In the course of implementing several global private networks, we have faced various problems.

4.1 REGURATORY MATTERS

Availability of digital leased circuit service in each country or city is the most fundamental concern at the time of system desugn. Where unavailable, we have to consider existing analog leased circuit or public networks, which causes the restriction of services that can be provided by the network.

Reguratory issues like public-private interconnection and type approval requirements cause us difficulty because they vary from country to country. They affect the network configuration design and the means to manage and synchronize the implementation schedule.

4.2 NETWORK TOPOLOGY

It is important to determine the location of network hubs. The determining factor may be the minimization of operating costs, ot the importance of a certain corporation's business footings, or the location of communications traffic. We have to consider all factors comprehensively.

Then, the network topology is determined, taking into consideration the flow of trffic, volume of traffic and reliability requirements as well as the network cost. Although a triangle or loop topology is a valid for reliability, it requires a lot of money. However, a star topology is difficult to circumvent a fault condition.

4.3 MULTI-VENDOR ARRANGEMENT

In general, we must use network equipment on a multi-vendor basis because it is difficult for a single vendor to supply every kind of equipment to every country according to the customer's requirements. Furthermore, we must contract with plural carriers including international and domestic carriers, many transportation companies and many engineering companies.

The required multi-vendor arrangement is very important to keep the project on schedule and to deal with a lot of contract documents.

4.4 TECHNICAL MATTERS

Although there are various methods of voice compression, an opinion test will be needed to evaluate whether the end user is satisfied by the quality or not, prior to the final dicision of the customer. At any rate, a class of 8 kbps or lower will be used most often for the time being.

In case of Japanese corporations, especially, demand for G3 facsimile communication is very large. Until recentry, mostusers utilizes voice channels encoded by 64 kbps PCM or 32 kbps ADPCM which can penetrate the facsimile signal as well as the voice signal in a leased circuit application. However, when the voice channel is compressed to the extent of 8 kbps, the channel cannot accommodate the facsimile signal.

Cases of circuit failure occur more often than those of network equipment, especially in local areas. It is very important for a network manager to get valid information concerning failure and to request the carrier concerned to remedy the situation as soon as possible. In view of technology and operation, it is necessary to determine whether to select centralized management or decentralized management.

Migration from existing networks to newly established networks is required to maintain the existing services. Therefore, we have to give careful consideration to the procedure. In some cases, it may be necessary to leave the existing network as it is for while, e.g. a week.

4.5 CUSTOMERS' INCENTIVE FOR NETWORK INTRODUCTION

In most case, customers plan to introduce their private network for the purpose of reducing the operating costs of communication. However, some customers don't know the total amount they pay for communication costs, because they usually use several mediums and several services. In this case, they have to get their payment records with the call destination information from the carriers concerned. If they don't maintain reliable data concerning their current communication costs, it is difficult for them to get an approval to introduce a new system.

Another incentive is a requirement for network system reliability. Some countries do not have the international gateway capacity enough for public services. In such a case, a certain customer established their private network using leased circuit, although it was not cost-effective. In view of communication quality, all communication links do not give the same quality

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because of the different quality of individual link. That is another problem, too.

4.6 EFFICIENT INTEGRATION CAPABILITY

In general, it is difficult for a customer to integrate several pieces of communication equipment in a network and to manage the implementation project. It is because there may be several problems such as multi-vendors, regulations, schedule control, etc. due to the fact that it is a multi-national project. Therefore, it will be better for the customer to appoint an adequate network system integrator, which requires more money, but will ensure the project completion and also teach practical skills to the project staff if they join the implementation.

5. TECHNICAL TREND

The technologies to be used in global private network implementation proceed according to customers' requirements.

5.1 VOICE COMPRESSION

In most domestic network, 32 kbps ADPCM is used for voice compression applications, because it provides good voice communication quality and G3 facsimile communication capability. Recently, 16 kbps APCAB has become influential because of the line cost benefit.

In global networks, however, the 8 kbps system is used most often because international digtal leased circuits are so expensive. Therefore, 8 kbps voice compression technology is advancing and the quality is becoming better. It will be quite practical in combination with the echo canceller, especially in using satellite communication service.

5.2 FACSIMILE SIGNAL CONVERSION

In order to send a facsimile signal through an international digital leased circuit, we have two options at the moment. One is the FMS, which first stores the facsimile signal on a digital signal basis and then transfers it to another FMS through a data channel of, e.g. 9.6 kbps. The destination FMS then sends the signal to the destination G3 facsimile terminal based upon G3 protocol. This system could give us additional values such as a broadcasting function. Another is the special CODEC which enables the penetration of facsimile signals as well as voice signals on a 16 kbps basis. In this system, the G3 facsimile signal is converted to 9.6 kbps digital bit stream and goes through the 16 kbps band-width as a data signal. Therefore, the quality doesn't diminish in spite of a narrow band-width.

Of course, utilization of the G4 facsimile machine is another choice.

5.3 EFFICIENT MULTIPLEXING

Since different manufacturers of TDM equipment utilize different mixes of technologies resulting in a unique algorithms, TDM is incompatible with different manufacturers. However, this gives the manufacturers a unique and efficient design for multiplexing.

The latest technology for multiplexing is based upon packet processing technology. A product uses packet technology as one of the voice compression measures, and another product uses it to interpolate a "packetized" data bit stream into idling time-slots of voice channels.

5.4 AUTOMATIC ROUTING

In case of utolizing an 8 kbps or 16 kbps voice compression system in the multi-node network, the restriction of the number of transmission links is very severe. Two links of 8 kbps gives an extremely low grade of voice quality.

In order to maintain one digital link of 8 kbps, some TDMs implement a routing function within themselves. This system also enables an adaptive routing, which means that the physical path between the original node and the destination node will be set up on call originating. It ensures further network reliability.

6. CUSTOMERS' TREND

Customers have various approaches to planning the introduction of their global private networks. Their objectives vary, too.

6.1 MOTIVATION OF PRIVATE NETWORK INTRODUCTION

In general, it is difficult for a customer to start the network service around the world at one time. Therefore, most custmers plan to introduce the network on a step by step basis. For example, a typical customer will introduce single communication link to the routr which is most often utilized, then expand the network according to the users' requirements. This type of approach is probably attributable to the internal approval process that the planning manager must cope with. It is easier for him to receive the management's approval of a single link extension compared with that of an entire global private network.

On the other hand, some customers plan to introduce the network strategically. A certain customer introduced the network to upgrade their services for their customers and partners. Another customer aimed to be a VAN service provider in the future. They also in tended to get an advantageous position in the market.

6.2 QUALITY-ORIENTED APPROACH

Many customers expect communication quality to improve. Therefore, they prefer a leased circuit to a public network, an optical fiber marine cable to a satellite, a 16 kbps voice to an 8 kbps, and so on. This means that leased circuit charges will be the dominant factor for customers deciding on network introduction.

6.3 NEW-MEDIUM UTILIZATION

The most popular current applications is of voice, facsimile, data and telex. However, a new demand for video application has appeared. The TV Conferencing System, utilizing 64 kbps or 128 kbps, is advancing in quality. As a TV Conferencing System is very attractive for business men who go back and forth between Tokyo and New York, for example, the number of customers who wish to add the system to their present network or to use the private system with CAD/CAM data communication is on the rise. Consequently, demand for higher rate digital leased circuits such as 128 kbps or 384 kbps will increase.

6.4 HIRING OF SYSTEM INTEGRATOR

The more complicated the network system becomes, the more difficult it becomes for a customer to handle and manage the implementation project. Furthermore, it will be very hard fot a communication manager to coordinate vendors and carriers during a system failure after the commissioning. Therefore, customers tend to use a network system integrator as the contractor or the consultant. This is useful in an inevitable multi-vendor environment.

7. CARRIERS' TREND

Major carriers in the world are going to accept the customers' trend to construct their own networks and are going to be active preparing their original service program.

7.1 JOINT ACCOUNT MANAGEMENT

Major carriers have their own corporate customers and they need to assist the customers in the formation of their global private networks. However, each carrier is not necessarily familiar with the various conditions of foreign countries. Consequently, they cooperate with each other to support the customer, which is called "Joint Account Management". Domestic carriers as well as international carriers take such an approach.

7.2 FACILITY MANAGEMENT SERVICE

Carriers are able to maintain their building services on a 24 hour a day basis. On the other hand, some customers can not afford the floor space for network equipment in a metropolitan area and a 24 hour a day maintenance organization. Therefore, carriers provide the Facility Management Service in their buildings in major cities, e.g. Tokyo, New York and London. They provide equipment maintenance services as well as housing services, if required.

7.3 ISDN

Major international carriers have started an international ISDN service. At the moment, they offer only basic rate interface. But, a primary rate interface will be available in the future. At any rate, low traffic applications such as TV conferencing will be used most often.

7.4 VIRTUAL PRIVATE NETWORK (VPN)

In the U.S., Virtual Private Network service has become popular, because the carrier can provide the entire private network service and the customer need only subscribe to the port of service.

If the international carriers would take this concept into the global network business, it would be very useful for customers. However, there would be some subjects to be solved, e.g. technical and managerial matters.

8. CONCLUSION

Global private network introduction is sure to be an inevitable trnd of major corporations. The global private network oriented approach will advance according to the changes in international states of political and economic affairs.

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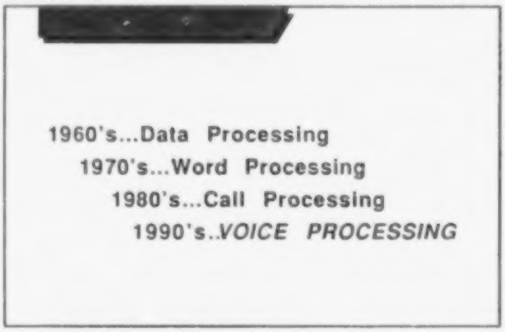
The Use of Voice Processing for Today's Business World

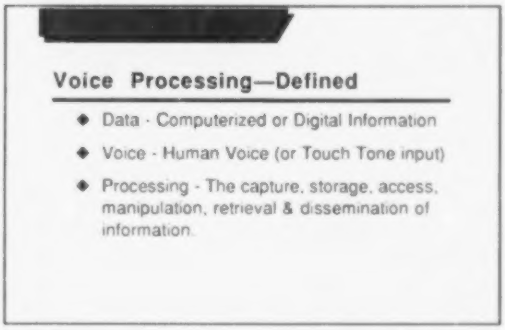
Marc Ostrofsky, Publisher
Voice Processing Magazine
Houston, Texas, USA

Good morning, my name is Marc Ostrofsky and I am President of Information Publishing Corporation, a Houston, Texas-based company that publishes *Voice Processing Magazine* and *Public Communications Magazine*. *Voice Processing Magazine* covers voice information products, services, applications and technologies. I can be reached at 713-974-6637. We also sponsor numerous conferences and exhibitions such as VOICE, TeleMedia, PACE and Call Center Management. Today I will be speaking on "The Use of Voice Processing for Today's Business World".

With changing times, there are changing technologies:

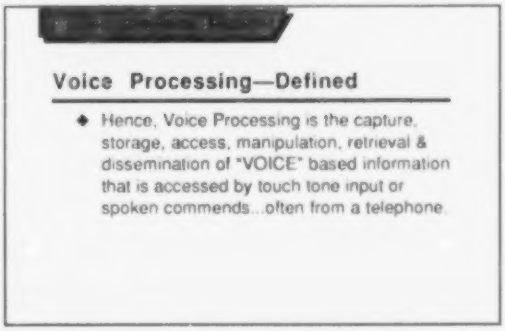


1960's...Data Processing
1970's...Word Processing
1980's...Call Processing
1990's..*VOICE PROCESSING*



Voice Processing—Defined

- Data - Computerized or Digital Information
- Voice - Human Voice (or Touch Tone input)
- Processing - The capture, storage, access, manipulation, retrieval & dissemination of information.



Voice Processing—Defined

- Hence, Voice Processing is the capture, storage, access, manipulation, retrieval & dissemination of "VOICE" based information that is accessed by touch tone input or spoken commends...often from a telephone

Applications Are the Key To Understanding

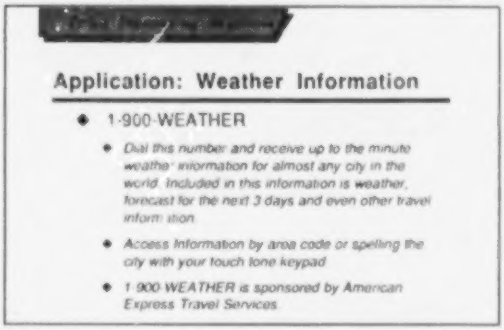
Voice Processing and Voice Processing Magazine breaks up our coverage of these applications into 6 areas:

1. Voice Mail & Integrated Messaging
2. Interactive Voice Response
3. Call Processing & Call Center Management
4. Telemarketing & Transaction Processing
5. Voice Information Services (800, 900, 976, DDD, Local and Gateway access)
6. Speech & Voice Technology (Speech Synthesis, Speech Recognition and Text-To-Speech)

Some people think of Voice Processing as their "middle management" tool while others think of it as a "time management" tool because it actually "adds" 2 hours to the work day by turning unproductive telephone time into productive time. It is estimated that over 85% of the FORTUNE 1000 currently use some form of Voice Processing technology.

The technology can automate routine functions, access database information and save time and money by facilitating the movement and communications both inside and outside your organization.The easiest way to explain VOICE PROCESSING is via APPLICATIONS of the technology that are saving companies-time, money and creating a streamlined, more efficient organization...and, in some cases, eliminating middle management.

There are many, many VOICE PROCESSING General Business Applications used in nearly every industry. My discussion will cover numerous applications of the technology.



Application: Weather Information

- 1-900-WEATHER
  - *Dial this number and receive up to the minute weather information for almost any city in the world. Included in this information is weather, forecast for the next 3 days and even other travel information*
  - *Access Information by area code or spelling the city with your touch tone keypad*
  - *1-900-WEATHER is sponsored by American Express Travel Services*

Improve Customer Service:

Apple Computer has installed call and message processing systems in as many as 70 locations to increase communications with customers, prospects and employees. John Scully says "Customer Service is #1 at APPLE" and Voice Processing is helping them achieve that goal.

Wake Up Calls & Call Back Services:

Hotels, like Ceaser's Palace in Las Vegas, Hospitals, 1-900 & 976 Services, Pay Phone Owners or anyone needing to set up a particular call at a specific time use this application. The caller is prompted to press in the time the call is to take place and the day the call is to be placed. Then, if applicable, the message that is to be delivered is recorded.

Purchasing:

Voice Processing helps get competitive pricing and faster deliveries by storing detailed quantity, pricing and product availability. You can assign mailboxes to regular customers or vendors so they can "reach" the company around the clock.

Customer Service:

You can reduce holding time and project an image of reliability and courtesy with Voice Processing by allowing callers to transfer themselves to the desired department. You can also provide new product/service information with customized "bulletin boards".

Sales & Marketing:

Sales representatives can call in each day and report the days sales using voice mail or via voice response/touch tone input numbers directly into the database. They can also pick up messages 24 hours a day and transfer them to the appropriate parties with added comments.

Sales:

Voice Processing gives you touch tone access to price information, product availability and specifications and automated order entry. Callers can place orders directly with your database via touch tone entry.

Accounting:

Voice Processing delivers information on employee benefits and bank transfers quickly and easily by sending it automatically into their mailboxes. It will also collect inquiries and provide information about expense reports, vacation schedules and tax information without interruption.

Engineering:

You can deliver product development, status reports and scheduling information to product managers and marketing personnel with Voice Processing. By providing accurate technical specs in a specifica- tion's mailbox you will prevent the distribution of incorrect and possibly costly information.

Engineering:

Voice Processing allows the exchange of information about equipment availability without delays and speeds the delivery of laboratory reports and results.

Voice Mail can increase communication with employees and make it easier to communicate to large groups. It allows you to cut down on "chit chat" and get the point across. You can spend less time in meetings by using Voice Mailboxes to broadcast agendas ahead of time.

Sales & Marketing or Accounting:

Each Mrs. Fields cookie store manager is required to call their voice mail boxes each day via a 1-800 number to pick up messages from the home office and to leave, via touch tone input, the day's receipts.

Insurance:

Customers can automatically access Policy Information, Underwriter's reports, Claims processing, Billing updates, or leave a message for their agent using Voice Processing.

Real Estate:

Voice Processing allows prospective clients access to property information themselves such as the number of bedrooms, bathrooms and parking spaces; square footage; property taxes; best mortgage rates; loan officer contact; etc.

Real Estate:

Since timing is essential, private mailboxes set up for each agent lets buyers, sellers, lenders and architects stay in touch with voice mail. Important messages can automatically notify an agent via pager to call their voice mailbox.

Legal:

Voice Processing lets clients stay in touch with their attorneys at all hours of the day. Even better, Voice mail allows for confidential client information to be delivered confidentially because the client won't have to leave private information with the receptionist or secretary.

Voice Processing allows people to be flexible. They communicate when they want. They create more efficient "one way" conversations. Unproductive time becomes productive time.

Investments:

By using Voice Processing, clients can be sure their brokers get their messages accurately and on time, even though the broker is always "on the phone". Special clients can be assigned their own mailbox so that the broker can leave group messages for them when particular investments look good. Also, last minute financial decisions can be delivered to brokers, even after hours or between different time zones and corporate updates and information about mergers and acquisitions can be delivered to voice mail systems immediately.

Time Scheduling:

Airlines now have pilots and flight attendants call their mailboxes to retrieve flight information and changes just prior to flight time. Thus, voice mail allows time schedules, routes and changes to be posted to mailboxes in lieu of contacting personnel individually by telephone or memo.

Transportation:

Truckers can now communicate vital information or problems to other truckers and coworkers in the office without having to worry about business hour constraints or the difference in time zones.

Application: Receptionist

- Automated attendant technology answers the phone and transfers the call to the appropriate party when an extension number is entered. If the caller does not know their extension number, they can press 1 for a directory or 0 for an operator.
  - *Eliminates the majority of calls to receptionist/operator*

Information "Bulletin Board:"

This application allows employees or association members to access upcoming events, activities, policies, instructions or directions.

Construction:

Voice Mail can link Contractors, General Contractors, Sub Contractors, Owners, Bankers, Accountants, workers and all others to the day's events.

Application: Hiring

- When hiring, instruct candidates to leave appropriate information in a voice mail box designated for that purpose
- Messages are reviewed. The best candidates to interview are then forwarded on to the boss for review who in turn forwards them back with his/her comments.

Information Access:

Voice/FAX integration allows callers to call in for information such as Tax Forms, Job Applications, Price/Availability memos at their convenience. By entering a number corresponding to the desired information and then entering their FAX number, the information is retrieved from storage and is automatically sent to their FAX machine. This entails no human intervention at all.

Application: Health Information

- **Hospitals are putting up health information lines that allow callers to access a library of information about health related topics.**
  - ***Push 1 for AIDS***
  - ***Push 2 for Insomnia***
  - ***Push 3 for Headaches***

Application: Dealer Locator

- 1-800-OIL-LUBE
- Callers are told the nearest dealer location by pushing in their zip code.

Cellular:

Voice mail on cellular phones will answer a phone call if you're on the phone. Later you can retrieve your message from your mailbox. The cellular company gets additional air time sales.

University Enrollment:

The University of Texas hands out a catalog to students. Students call in, enter numbers corresponding to the classes they want to enroll in. They are then told that they are either enrolled or the class is full.

Voice Mail allows Group Distribution of your messages from 1 to 1 or 1 to 1000...with one phone call.

Banking:

Voice Processing allows a customer to access account balances, check clearances, loan, interest or mortgage rates, bill payments, etc.

Sports Scores:

You can get instantaneous sports scores and sports information updates accessed by Sport, Team & Player.

Credit Card Authorization:

Most retailers now call credit card authorization companies that have fully automated the input of the card number and output of the authorization code.

1-900-JOURNALPHONE:

The Wall Street Journal allows callers to enter numbers corresponding to stock symbols. They are then told the up-to-the-minute prices of the corresponding stocks.

Cable-TV:

Warner Cable in Houston allows viewers to call into a "Movie Line", enter their phone number and a number corresponding to the movie they wish to see. Within 5 minutes, the movie is shown on their TVs.

Warranty Status:

Callers enter in their warranty number and are told the current status of the warranty, where the closest dealer is and how to order an extended warranty.

Automotive Repair:

Callers enter their claim numbers and are given the status of repairs, cost, time it will be ready, etc.

Application: Currency Exchange Rate

- **Travel Agencies are providing custome with the latest currency exchange rates for other countries.**

¥ → $ → £

Travel Advisory:

People on the move need to know vital information about countries to which they are planning to travel. This line updates them when they spell out the name of the city or country, i.e., TEL AVIV is T-E-L or 8-3-5.

Talking Phone Book Directories:

A voice number is provided to each advertiser and the mailbox number appears in the ad. Callers can obtain advertiser information, leave messages or be transferred to the nearest dealers of sales offices. Advertisers can update their message daily, weekly or monthly to reflect changes in hours, sales, specials, etc.

Train Schedules:

The New York Transit Authority automates the train schedules for callers with touch tone phones eliminating misinformation, cutting the cost and speeding the handling of inquiries.

Marathon Race:

Marathon runners call an automated information number to get information on race conditions, weather, traffic, hotel, spectator routes and special events.

Newspapers:

The *Houston Post* offers "INFO-LINE". Callers can get coupons, daily discounts on merchandise, even play trivia. The cost to callers is free and is underwritten by advertisers.

Application: Trade Show Information

- Callers interested in VOICE '91/ Call Center '91 call 1-800-888-2188 and are told...
  - *Push 1 for Call Center '91*
  - *Push 2 for VOICE '91 Conference*

Associations:

Associations can give/rent mailboxes to members allowing them to communicate easily between one another.

Media Sales:

Sales and prices in the media business change hourly. Sales Managers for TV, Radio and Newspapers can leave messages for salesmen regarding availability and price.

IRS Tax Info Line:

You can call 1-800-TAX-4477, and hear recorded information and the current status of your tax refund.

Voice mail messages are accurate. Detailed research findings and client data can be retrieved at any time.

U.S. Department of State Bureau of Consular Affairs:

The Bureau utilizes 44 phone lines with three voice response systems to provide Office Hours, Instructions on applying for passports and instructions on obtaining copies of reports on deaths or births of U.S. citizens abroad.

Insurance:

Blue Cross/Blue Shield uses interactive voice response in several regional offices to better serve the needs of its customers. This allows them to capture information directly from the caller to be used in drug eligibility verification and internally to oversee administration of claims.

Sports Teams:

Every team in America, whether little league, varsity or professional can utilize voice mail for better communications such as sending group messages to team members, announcing changes in team line-up, time or location of match, update playbook, tactics, strategies, etc.

Sports Illustrated:

Sports Illustrated enhances its value by using a 1-900 number to provide readers with sports scores and information.

Golf Tee Times Registration:

Callers to the American Golf Corporation golf courses use voice response to get directions to local golf courses and to automatically make tee time reservations.

WNET-TV Fund Raising:

WNET-TV station in New York married 1-900 services with automated voice response to allow callers to "automatically" donate to this public television station.

ABC Television:

ABC Television enhances the value of its daytime programming through 1-900 services by providing soap opera updates and automatically signing up callers to receive their soap opera magazine.

JELL-O:

Jell-O used a 1-900 number to test a new product and offer free coupons that covered the cost of the telephone call.

Credit Card Information:

Credit card companies are using Voice Processing to allow customers to check current balance, report lost or stolen cards, or apply for increased credit limit.

Conclusion:

Voice Mail cuts down on message handling and phone interruptions during the day. It keeps information and communications moving even when people are unable to speak to one another directly due to schedule conflicts, time zone differences, etc.

How much technology is too much? This is the KEY question.

Different amounts are needed depending on the specific application.

Messages are fragile. The more they're handled, the more inaccurate they become.

Comparison of Pricing Approaches: Motivations and Effects

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1. ABSTRACT

Telephony pricing motivations are changing from a focus on cost recovery and public policy requirements to a focus on market requirements and competitive imperatives. Trends in the Pacific region respond to traditional driving forces such as new technologies that decrease costs, but also to these changed priorities, leading to regulatory perspectives that emphasize rate rebalancing to move prices closer to cost coverage by the cost causer.

2. INTRODUCTION

The pricing of telephony services is a complex and difficult task, handled differently in almost every jurisdiction. This paper does not purport to be in any sense a full analysis of pricing approaches, but will instead focus on two or three critical issues that inevitably arise when setting or altering end user prices, and some of the effects of how these issues are settled.

3. PRICING MOTIVATIONS

Prices are established for two entirely distinct reasons. First, costs must be covered, in whole or in part, and in the case of telephony, prices usually do cover the full cost of installing and providing service. Cost coverage, however, can be accomplished in various ways, and the results almost always require some piece of the total service to underwrite or subsidize other pieces. The reasons for this are partly economic and partly based on public policy.

Among the economic reasons, the chief one is the imbalance among telephony costs. The industry is characterized by high fixed costs and low variable costs -- a situation that has not changed and does not seem likely to change even as new technologies penetrate the network. In fact, the preponderance of fixed costs appears to be growing, if anything, as more and more components of service are mechanized. Operator services provides a typical example: at one time all calls required the assistance of the operator. Today a high proportion of calls in developed nations are directly dialed, including international calls. Among calls involving special billing arrangements, all of which at one time required live operator assistance, first Calling Card calls and now even collect and bill-to-third-number calls (and eventually person-to-person calls) are being automated, both from the central office and using on-site hardware such as computer chips or PBX adjuncts. Similarly, digital central offices make it cost-effective to install the capacity for many more lines than are needed, because it is much cheaper in general to do the installation once, rather than adding it on later, especially in areas where labor costs are high. The effect of all these is to increase the initial investment and decrease traffic-sensitive costs.

As a result, the costs of providing telephone service continue to be concentrated in initial investment and installation. Establishing service entails a high initial cost, while providing the service once it is established is relatively cheap.

Naturally it is impossible to recover the initial costs immediately, because that would make the price of entry into the telephone network too high for nearly all customers. A sense of just how valuable network access really is, at least for some users, can be derived from the actual price paid in countries where the only way to get a working telephone is through extensive and costly bribery. This rough and ready version of market-based pricing is itself the product of scarcity, and can in turn be the cause of scarcity. Official telephone prices generally have a completely opposite goal: universal (or at least broadbased) access. There are again two reasons for this goal, one economic and the other political.

Economically, the value of access to the network is enhanced every time another party obtains access. Each subscriber can now call the new subscriber, and can in turn be called by the new subscriber, thus increasing the potential utility to both old and new subscribers. As long as the network is sufficient to support all calls (that is, as long as it does not impose some limitation or prioritization because of scarcity of dial tone), utility rises with increased subscribership.

Politically, governments and telephone authorities have increasingly tried to make telephone service broadly available, moving it out of the luxury class and into that of an essential service. In the Pacific, economic development and telephone penetration have advanced hand-in-hand, with the highest penetration rates and the most rapid growth found in the leading industrial nations. The highest penetration rates worldwide are in the range of 40-50 lines per 100 inhabitants. Australia, Hong Kong, Japan and New Zealand are already in that range, with Singapore at about 35 lines per 100 not far behind. South Korea and Taiwan are in the 25-30 range, with generally rapid growth -- Taiwan at over 6% compound annual growth rate for the past five years, and South Korea at about 15%.

4. PRICE APPROACHES

The most effective and extreme pricing approach for achieving high phone penetration would of course be to give away access for nothing. An analogy here is parking at a shopping center: in order to make it easy for customers to spend their money, the parking facilities at the shopping center are free. Their cost is covered by the prices ultimately paid for goods purchased at the shopping center. In the telephony world, access is typically priced much below its actual cost (and value), but it is not free. In the Asia/Pacific area, an example of low access pricing is Hong Kong, where the monthly fee (including all local usage) is only USD5.50.(1)

Very low access costs and local calling prices encourage heavy use, and Hong Kong users are noted for their high levels of calling. Problems can arise, however, if usage-sensitive pricing becomes desirable. In the U.S., where companies have moved to substitute local measured service for flat rate service, there has often been strong protest. In the State of Indiana, for example, a law was passed to keep the local exchange carriers from making this change. In other locations, the change has been successful, but has usually required extensive education of both the general public and legislators, regulators and consumer representatives. In the case of Hong Kong, the ability to limit international calling by requiring an authorization code was influential in encouraging customers to accept IDD access, and upper limits on Datapak packet switching charges were also introduced to set customers' minds at rest about these usage-based fees. Telecom Corporation of New Zealand is presently phasing in local calling charges for business users (residence users continue to have flat rate service). Business subscribers will see a reduction in their monthly access charge as local measured service is implemented.

The principle of payment by the cost-causer is regularly invoked when measured service is introduced, but is not always convincing. In the case of local calling, it is not clear that this principle properly applies: local calls have very small marginal cost. The same battle must be fought, however, in cases where the formerly "free" service is very costly, for example where Directory Assistance charging is introduced. Even when they are measured, local call price structures often rely on some form of subsidy from longer distance calling.

The range of today's price structures in the Pacific can be gathered from a glance at Chart 1 below. Despite the great differences in geographies and in the ratio of local to long-distance prices, with the exception of Australia, the countries listed offer very low (or no) local call prices.

Chart 1

Local and Long Distance Calling Costs (USD)

	Local	25-50 Km	50-100 Km
Australia	.16 per message	.30/min.	.65/min.
New Zealand	free (residential)	.20/min	.28/min.
Hong Kong	free	N/A	N/A
Singapore	free	.05/min.	.15-.31/min.
Korea	.01/min.	.04/min.	.37/min.
Japan	.02/min.	.27/min.	.56/min.

Once again, this relationship, where local calls are priced lower than long distance calls, does not accurately represent costs. In fact, the costs that are essential for carrying local calls -- the local loop and local switches -- are a disproportionate share of the total costs. (These costs are also essential for all longer distance calls.) But local calling is typically subsidized by longer distance calling -- that is, the long distance calling carries more than its share of the local loop costs -- at least to some extent. In the United States, this subsidy was embodied at divestiture in access charges, and has since been shifted largely to end users in the form of the End User Line Charge (EUCL) -- about USD2 per residence line and USD6 per business line. Subscribers thus pay a separate flat fee to cover some non-traffic sensitive network costs, in addition to their local telephone company's monthly access charge.

International calls have traditionally provided an even greater subsidy than domestic long distance, being priced vastly above their costs, even when those costs were much higher than they are today. In fact, the distance-sensitive proportion of costs has dropped significantly, and there is little current economic justification for rating calls by distance.

The justification for reduced local calling prices is again both economic and political. Residence users tend to make more local calls, and residence users usually are provided with lower price structures. For example, as noted above, Telecom New Zealand is ending its flat rate business service while retaining its flat rate residence service. The monthly rate for residence, however, is USD18.60, while that for business is USD40.42. Hong Kong also charges more for business service, and that is the standard pattern in the U.S.

One economic justification for charging residence callers less depends on peak pricing. If the network must be engineered for traffic at its most dense, and if the cost of actually carrying a call is trivial compared to the cost of putting in the plant, then the whole cost of the network can be viewed as an outcome of peak traffic requirements. Calls at non-peak times are, in this perspective, marginal, and cost almost nothing. Since peak traffic is largely business traffic, business access rates should be higher than residential rates. And rate reductions for off-peak periods are economically justified. With the penetration of digital switches where installing capacity exceeding peak requirements is more cost-effective than adding capacity in increments, the economic logic begins to look less realistic. Politically, of course, it continues to be attractive to make calling less expensive for residence subscribers.

All these pricing approaches have been standard, to varying degrees, for many years. There are a few other pricing issues that are less standard that have been growing in importance in the U.S., and that may suggest possible developments elsewhere. For several types of service, service providers have found themselves paying commissions to owners of locations or equipment. For example, payphones in the U.S. have traditionally paid a share of revenues generated at the phone to the site owner -- a sort of floor space rental. At one time AT&T paid commissions to hotels on the operator assisted calls that emanated from those hotels. That policy ended before divestiture, but has since been revived in response to competition. Similarly, telephone companies sell Centrex services through independent sales channels, remunerating them via commissions. These commission payments are all "price" terms, although they are not actual prices paid by end users, but rather givebacks on those prices -- and givebacks to an intermediary entity rather than to the end users paying the actual prices. As competition has entered U.S. markets for public telephones and operator services, these commissions have become increasingly critical to achieving and maintaining penetration in the payphone and operator services market. Providers compete for locations on the basis of these commission payments.

5. CHANGING APPROACHES

This type of price competition is only one of the ways that pricing has been changing in the past few years. As noted above, costs themselves have altered, both in overall level and in terms of their interrelationships. And cost changes have direct effects on prices. For example, as more direct dialing has been available, the average long distance or international call has dropped in price, even without any actual price changes, simply because direct dial calls are priced lower than calls requiring operator assistance. And prices have been reduced because costs have dropped: the capital cost per voice-grade-equivalent half-circuit on TPC-3/HAW-4, for example, is estimated at USD39,900, while the cost of the earlier analog TPC-2/HAW-3 was USD127,600 -- more than fifteen years ago. In fact, these analog channels have a depreciated cost of about USD60,000 per half-circuit -- more than the new capital cost of the fiber optic cable. These numbers do not take into account the increased circuit derivation capabilities of digital channels, nor are they adjusted for inflation.

But cost changes alone do not account for the rapid changes in pricing that have been taking place worldwide. More important are the changed goals that pricing has been asked to support. In the United States, competitive providers handling most long distance calling are not the same as providers of access and local transport. That fact has created the need for rate rebalancing, because retaining the traditional rate subsidies would make the dominant carrier (in this case AT&T) uncompetitive in price. The same rebalancing requirement has developed where competition for local or short-haul traffic exists, which is now the case in many U.S. jurisdictions.

Where competitors can target high end business users, for example, pricing has had to change, permitting volume discounts and other types of price reductions. These include tapered pricing in accord with contract duration, multi-location pricing, and package pricing ranging from Optional Calling Plans for local and long distance calling, to AT&T's customized Tariff 12 packages. The goal of such time, location and package pricing arrangements is to encourage end users to commit to multiple services from a single vendor, for a protracted period of time. In short, these price approaches reflect market and competitive requirements, and not either costs per se or specific public policies.

Even in countries where all service provisioning comes from a single entity and where competition in basic services does not yet exist, rate rebalancing is an issue. As noted in a recent OECD study, the cost-of-service pricing approach seeks "optimal allocation of resources that should occur in an open, competitive market."(2) These are essentially operating costs plus infrastructure maintenance plus investment plus research and development requirements.

In the Pacific, the direct effects of competition are most clearly seen in Japan. Traditionally, Japan has been an 'expensive' country for telecommunications.(3) Since 1986, NTT has been reducing its prices. Longer distance calls in particular have dropped in price. With the advent of competition in 1985, local calling also effectively became access for interconnection. Under pressure, NTT reduced short-haul prices (less than 30 km outside the local message area) by one-third. In 1990, a 15% price drop for calls beyond 320 kilometers was scheduled. In addition, discounts of various types have been implemented.

The greatest price reductions have occurred in international calling: KDD claims twelve price decreases since 1979. Most recently, rates dropped 21% in 1988, 14% in 1989 and 7.7% in April 1990. Prices for some calls from Japan to the U.S. are now lower than prices for calls in the other direction -- a unique situation.

Japan offers an excellent example of rapid growth combined with rapid price reduction and rebalancing. Like the U.S., Japanese pricing has responded to competition by allowing prices to match costs more closely. Satisfying large customers is increasingly important, and the cost advantages provided by volume installations are more and more being passed on to these customers. Thus KDD has instituted a program where a back-up international T-1 is priced at only 60% of the first, effectively providing a 20% discount on the pair. In addition, Route KDD service permits bypass of the local loop for a savings of about 15%.

Price changes have occurred in countries where competition does not exist, however. To a great degree this is because the whole world's telecommunications market is increasingly a single market. While individual residence users have no choice of carrier, business users often have the broadest possible choice, because businesses are increasingly global. They can move their headquarters, or pick their new locations, in part because of the telecommunications support they receive. In the Pacific, where several different localities are viable sites for primary or hub locations, this trend is especially clear.

Singapore and Hong Kong, for example, are both actively stressing their positions as hubs for traffic of all types -- shipping, travel, and telecommunications. In a multi-client study CSMG did of telecommunications demand in the Pacific region, we asked 55 large end users about their network structure. Excluding hubs in home countries, we found that out of a total of 63 hubs, Hong Kong had the most -- 19 -- followed by Japan with 15 and Singapore with 13. Australia had five, and several other countries had one, two or three.

Australia is also emphasizing hubbing. OTC noted in its Annual Report for 1990 that PacRimEast "will enable OTC to further pursue the objective of making Australia the telecommunications hub of the Asia/Pacific region" (p. 8) OTC boasts several times of its success in getting SITA to move its headquarters to Sydney from Hong Kong, and notes that private leased circuits will be a focal point because of their role in "regional telecommunications hubs, a market segment which OTC is making intensive efforts to attract to Australia." (OTC 1990 Annual Report, p. 11)

Asia/Pacific telecommunications leaders are looking to each other and to other worldclass telecommunications providers in establishing both service and pricing levels. Singapore Telecom is known for its benchmarking in all aspects of service -- and increasingly, pricing will be a critical comparative factor. Hong Kong Telecommunications International notes in its 10-K, "In setting charges, HKTI takes account of charges for similar services in other countries ..." (1990 10-K filing, p. 17) Competition, in short, is no longer a strictly local phenomenon. End users repeatedly told CSMG that they looked at both international and domestic rates along with quality of service when planning facilities and evaluating locations.

6. FUTURE TRENDS

As a result, we can expect to see continued pricing shifts. Prices will drop, and prices will move closer to costs. This will pose problems for telecommunications authorities seeking to satisfy public policy goals such as low price service initiation, access and local calling, because these goals will conflict for financial support with the need to be price competitive across an international arena. Fortunately, mechanization and improved technology will help by broadly reducing per-unit costs. And price reductions themselves can be expected to spur usage, especially in the growing international sector.

We believe that the effects of price changes in this arena have yet to be felt, even though considerable price reduction has already occurred. In our study, we compared the international prices of nine Pacific countries. We note that the private circuit crossover points were much the same for all the countries -- it is cost-effective to move from an M1020/1040 line to a digital line (56/64K) once there is enough traffic to fill roughly two M1020/1040 lines. At about the point where traffic requires six to eight 56/64 K lines, a T-1 becomes cost-effective. These cross-over points are similar to those found in the U.S. and Europe.

The actual price levels, however, are vastly different from country to country. Taiwan is by far the most expensive country in our sample, in all categories. In general, the U.S. is the cheapest. The striking point, however, is that IMTS usage growth rates (the only ones widely available) bear no clear relation to prices. In fact, the greatest growth in IMTS between 1984 and 1988 (the years for which we have actual data) was experienced by Taiwan, the country with the highest IMTS prices. The IMTS growth rates appear below.

Country	Compound Annual Growth Rate 1984-1988
Taiwan	54.4%
Hong Kong	52.6%
Korea	50.6%
Thailand	40.1%
Japan	39.3%
Malaysia	37.7%
Singapore	37.4%
Indonesia	29.3%
Australia	27.3%
Philippines	22.4%

(Source: AT&T, *The World's Telephones*, various editions.)

Yet price elasticity of demand is a real force. When CSMG studied demand in the Atlantic, four years ago, we asked very large end users whether they viewed international calling as "expensive". Most did so view it -- and they employed a variety of techniques to limit this calling, such as restricting some phones from placing international calls. Once the psychological barrier that suggests that international calling is "expensive" is overcome -- and it has been rapidly crumbling -- we can expect even greater international calling growth. Price perception is an important component in this psychological barrier.

For our Pacific demand study, we addressed the issue of price elasticity directly. We asked for forecasts of private line usage, first without specifying any price changes, and then with price drops varying from 20 to 60 percent over a five year period. Most respondents told us that they anticipated about a 20% price reduction. But greater price drops called forth considerably higher end user forecasts -- on the average, about 50% higher.

From the usage data we have gathered, the price trends we see underway already, and the projections of knowledgeable business users, we can make some broad estimations of the direction of Pacific pricing and its effects. We believe rate restructure will continue, with international traffic slowly giving up much of its present high margin. We believe that rapid growth in international traffic will also continue, and will be given an extra push by vastly increased capacity and associated price reductions. Pressure from large global users will influence provisioning and pricing on the national and local level as well, pushing these rates closer to costs. In places where domestic competition develops, the process will occur more rapidly, but the increasingly interlinked worldwide market for communications will affect even those areas where there is no local competition. As margins are wrung out of the traditionally subsidizing services, authorities will need to find other ways to achieve the public policy goals that have hitherto been supported through these subsidies.

(1) Price comparisons can be made in a variety of ways, including (in order of increasing complexity) translation into a single currency, comparison in terms of purchasing power, and calculation of the amount of worktime typically required to pay the price. I have used the simplest, single currency translation.

(2) OECD, *Performance Indicators for Public Telecommunications Operators*, No. 22, OECD, Paris, 1990, p.81.

(3) See Figures 1-5 in *Study on National Telephone Tariffs Worldwide*, Siemens, 1988, or Figures 4.10 and 4.11 showing the OECD residential and business tariff basket prices in 1979 and 1988 -- where Japan is most expensive in both services in both years (OECD, *op. cit.*, pp. 85-86).

Measurement of Productivity and Marginal Costs for Price Cap Regulation of Telecommunications Services

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ABSTRACT

A productivity target figures prominently in price cap or incentive regulation of telecommunications. Issues in productivity measurement and interpretation, and associated measures of marginal cost and economies of scale are analyzed from the perspective of price cap regulation of local exchange carriers.

I. Introduction

In the last few decades, revolutionary developments in electronics have slashed the costs of switching and other forms of telecommunications equipment. The restructuring of the network due to the new electronic technologies in the 1970s and 1980s was one of the major driving forces of both AT&T's divestiture in 1984 and regulatory "reform" such as price cap regulation in the late 1980s.

Traditionally, federal and state regulatory agencies have used rate-of-return regulation to set rates and profits for utilities. Under this type of regulation, prices are set so that the utility is allowed to earn a specific return on its investment after recouping its operating costs. Critics of rate of return regulation allege that, since the utility's rates are reduced in response to decreases in its costs, the utility may have little incentive to minimize its costs or engage in product innovation. In addition, Averch and Johnson (1962) have shown that theoretically under rate-of-return regulation, the utility may have an incentive to overuse capital.

Under a "price cap" form of regulation, the regulatory agency sets a ceiling on the price rather than on the rate of return. The utility has pricing flexibility below this ceiling, e.g., the regulated utility can raise or lower prices as long as the prices stay at or below the cap.

This approach is asserted to be more efficient than rate-of-return regulation. Under this new form of regulation, the utility is expected to have stronger incentives to make profits from cost-reducing innovations, since its rates would not automatically be adjusted downward. A utility that improves efficiency and responds to consumer demand effectively would see its profits rise. Therefore, it would help strengthen the competitiveness of American industry in domestic and international telecommunications markets and help ensure that consumers share in the benefits of the information age through lower rates and a wide array of high quality services.[1]

Since 1989,[2] the Federal Communications Commission (FCC) has concluded that price cap regulation is superior to rate-of-return regulation for certain dominant carriers. Price cap regulation for AT&T was first adopted by the FCC on July 1, 1989 and price cap regulation for the local exchange carriers[3] (LECs) will be implemented by Jan. 1, 1991.

In the price cap formula adopted by the FCC to determine the price ceiling for carriers, a productivity index is one of the major factors to modify allowable increases in production costs. In this paper we focus on measurement of productivity and marginal costs in the price cap regulation of telecommunications services. Productivity measurement for price cap regulation is discussed in Section II. The problems of using productivity in the price cap formula are evaluated and discussed in Section III. The concept and interpretation of productivity are discussed in Section IV. The approach to measurement of productivity is demonstrated in Section V. Section VI demonstrates resolving marginal cost into input prices and productivity components. Our conclusions are presented in Section VII.

II. Productivity Factor and Price Cap Regulation

The price cap regulatory approach adopted by the FCC for tariff review purposes for AT&T and proposed for the LECs operates according to the following process. A carrier's services are grouped together in accordance with common characteristics, and the weighted prices in each group are adjusted annually pursuant to the following formula designed to ensure that rates are based on the cost of providing service.

The price cap formula is as follows:

$$(1)\quad PCI_t = PCI_{t-1}[1 + w(GNP\text{-}PI - X) + \Delta Y/R + \Delta Z/R]$$

where

GNP-PI = the percentage change in the GNP deflator between the quarter ending six months prior to the effective date of the new annual tariff and the corresponding quarter of the previous year,
X = productivity factor,
ΔY = (new access rate − access rate at the time the PCI was updated to PCI_{t-1}) × (base period demand),
ΔZ = the dollar effect of current regulatory changes when compared to the regulations in effect measured at the base period level of operations,
R = base period quantities for each rate

element "i," multiplied by the ratio of the price for each rate element "i" at the time of the PCI to updated to PCI_{t-1},

w = R – (access rates in effect at the time the PCI was updated to PCI_{t-1} × base period demand) + ΔZ, all divided by R,

PCI_t = the new price cap index (PCI) value, and

PCI_{t-1} = the immediately preceding PCI value.

The formula in (11) reflects

(a) changes in the costs of input factors of production through use of the Gross National Product Price Index (GNP-PI);

(b) a productivity offset (X) representing the historical difference between AT&T's (or LECs) productivity improvements and productivity gains in the economy as a whole;

(c) certain specific cost changes beyond the carrier's control. These "exogenous costs" consist of cost changes due to changes in laws, regulations, or rules, or due to other administrative, legislative, or judicial changes beyond a carrier's control;

(d) a consumer productivity dividend: an additional 0.5 percent productivity offset that exceeds the historical productivity of the telephone industry due to the additional efficiencies from the improved incentives created by price cap regulation.

In most respects, this price cap formula is applied to both AT&T and the LECs. Because of the possible variability of individual LEC productivity around the industry average, the FCC has proposed some additional "backstops" such as a shared earnings and lower end adjustment mechanism in price cap regulation for the LECs. These backstops are designed to assure that the LECs would have strong financial incentives to improve productivity and that the rates charged to customers would fall inside the "zone of reasonableness."

The productivity index is one of the essential factors in the price cap formula. Productivity gains in a firm or industry represent increases in outputs from the same amount of factors of production, or equivalently, the same amount of output from input factors. In either case, the unit cost of output declines due to the diminished factor requirement per unit of output. Therefore, productivity gains would offset the price of output.[4] We discuss how the FCC determines the magnitudes of the productivity offset in the price cap formula for both AT&T and the LECs in the following section.

A. Productivity Offset in the Price Cap for AT&T

To determine a value for the productivity offset, the FCC first reviewed existing productivity studies for AT&T. On the basis of these studies, it found that the productivity differences between the telecommunications industry and the whole economy ranged from 1.9 percent to 4.09 percent.[5] The FCC then decided a productivity factor of 2.5 percent was appropriate in the price cap formula for AT&T, based on the long term historical studies of Bell System productivity, as well as its analysis of AT&T cost and revenue changes since 1984.[6] This productivity offset did not include a 0.5 percent consumer productivity dividend.

B. Productivity Offset in Price Cap Regulation for the LECs

In the FCC's proposal, productivity of the LECs for price cap regulation is not to be measured directly. Instead, two indirect approaches are offered: (1) output price difference between the telephone services and the entire economy;[7] and (2) "break-even" productivity approach.[8]

In the output price difference approach, productivity was measured by the difference between the telephone service price increases and the price increases of the entire economy as measured by the CPI or the GNP deflator. In the "break-even" productivity approach, the FCC computed a productivity factor such that rates would have been the same under a price cap regime as they are under rate of return regulation. The problems in using these two indirect approaches are discussed in the Section III below. Based on these studies, the FCC decided to proceed with a 3.3 or 4.3 percent productivity factor in the price cap formula for the LECs, depending upon the level of shared earnings.[9]

When using a 3.3 percent productivity offset to establish prices, LECs must share with their customers 50 percent of their earnings between 1 to 5 percent above the 11.25 percent level, and share 100 percent of their earnings above 16.25 percent. If a LEC chooses to lower its set prices further by using a higher productivity offset of 4.3 percent, the LEC can retain more of its earnings if it subsequently is able to earn higher profits through improved efficiency. In this case, the LEC can retain all of its earnings up to 2 percent above 11.25 percent. LECs would share with their customers 50 percent of their earnings between 2 to 6 percent above 11.25 percent, and share 100 percent of their earnings above 17.25 percent. The FCC also proposes a lower end adjustment mechanism. If a LEC's earnings drop below the lower end figure established, i.e. 11.25 percent, the LEC is entitled to a prospective automatic upward adjustment to its cap.

III. Major Problems in Using Productivity in Price Cap Regulation

A. Weakness in Direct Measurement of Productivity: Ignoring Quality Change

In most of the previous productivity studies reviewed by the FCC listed in footnote 5 above, total factor productivity growth was measured directly. The major sources of input and output prices in these productivity studies have been taken from either the U.S. Department of Labor, Bureau of Labor Statistics (BLS) or the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). The price indices from these sources were developed by the so called "matched model method." This method assumes the quality of products remains the same through time and ignores quality changes due to rapid technological change. Since there is no adjustment for quality change in these studies, their results overstate prices and understate output. The resulting estimates of TFP growth are therefore lower than "true" productivity growth, after quality-change adjustment.

The importance of a quality-change adjustment in the measurement of productivity, particularly for information-technology industries and their associated service industries, is demonstrated clearly in Jang and Norsworthy (1988a and 1988b) and Norsworthy and Jang's (1991) productivity study. The last study is based on an analysis of the computer industry which can be a useful proxy for understanding technological progress the telecommunications industry. Jang and Norsworthy computed the TFP growth for the U.S. computer industry by a direct measurement approach, with a quality-adjusted price index developed by Cole et al. (1986) at IBM and Triplett (1989) at BEA. Based on the quality-adjusted price index, Jang and Norsworthy[10] measured the average annual rate of total factor productivity growth for computers: about 26.3% for the period 1959-81.

Semiconductors, computers and telecommunications equipment are major inputs in the telecommunications services industry. The rapid albeit unmeasured technological change incorporated in these inputs has played a critical role in the decision to deregulate in the telecommunications service industry. To measure a reasonable and acceptable productivity growth used in the price cap formula for the telecommunications service industry, it is thus necessary to measure the prices and quantity of its inputs and outputs properly so that the likely impacts on future productivity due to technological change on the inputs and outputs can be considered. In particular, since much of the productivity gain in telecommunications has been based on "upstream" technological change, uncritical use of historical productivity growth as a guide to future growth is an implicit forecast of matters largely beyond the scope and control of the telecommunications industry.

B. Weaknesses in the Indirect Measurement of Productivity

There are weaknesses in both indirect measurement approaches on which the FCC's proposed productivity offset for the LECs is based. The indirect measurement of output price difference refers to the method whereby the telecommunications productivity growth is defined as the difference between the rate of growth in telephone prices and the growth in the entire economy. The objection to this output price difference approach is based on the fact the growth rate for telephone prices can be attributed to both productivity gains and increases in input prices. Thus, one can use output price differences to estimate productivity growth differences for two entities only under the assumption that (1) excess profits are zero in every period and (2) input price growth is the same for the two entities. These assumptions are clearly not valid in the telecommunications industry, where wage gains have exceeded the national average.

The "break-even" productivity approach starts from the assumption that price, set under a rate of return regulation regime, is based on efficient costs. This is a paradoxical assumption because the demand to alter the current regulatory regime is founded on the notion that rate of return regulation does not provide incentives that insure that firms act efficiently. It assumes that price changes are caused either by input price change, other exogenous forces, or productivity gains as shown in the above price cap formula. The unknown productivity factor then can be computed by subtracting the price changes occurring under rate of return regulation from the sum of both inflation estimate and exogenous factors.

These two indirect approaches are based on unreasonable assumptions. Therefore, the productivity factors computed from these indirect approaches are very likely to be biased. A direct measurement of productivity growth is inherently superior to the indirect estimates.

IV. Concepts and Interpretation of Productivity

Productivity is a ratio of output to the inputs used to produce it. The productivity of a telecommunications company, when correctly measured, is an index of the company's efficiency, and can be used to compare its efficiency with other companies. Productivity growth, measured properly, also provides a basis for intercompany comparison, and shows the dynamic performance of the company, including the economic gain available for price reduction and/or enhanced return on investment.

In order to use productivity as an accurate measure of performance, the measure of productivity must be constructed according to a few key principles derived from economic theory. These principles require that:

a. the productivity measure is the ratio of all outputs or services to all purchased inputs.

b. the various outputs on services must be added together using weights based on the marginal costs of producing them.

c. the inputs must be added together based on their marginal productivities in producing the outputs.

A productivity measure that meets these conditions is called total factor productivity, abbreviated TFP. Only total factor productivity is related to the total unit cost of production in a way that makes it valid as an overall measure of economic performance, because it embraces all purchased inputs. An increase in TFP always corresponds to a decrease in total unit cost of production. A productivity measure that does not have these characteristics is not an adequate basis for intercompany comparisons of economic performance or for incentive-based gain-sharing. Productivity measures based on only one input, such as output per manhour, the commonly used measure of labor productivity, can be useful as partial guides to identify performance improvement opportunities. However, they do not tell the whole story. It is easy to imagine a case where capital is substituted for labor so that it raises labor productivity, but also raises the total cost of production because the capital costs more than the labor it replaces.

There are two common errors in measuring productivity for the telecommunications industry. One is to use value-added as a measure of output, and thus to recognize only the capital and labor inputs, omitting all other purchased materials and services. While commonly used for very aggregated sectors of the economy such as total GNP, value added is not useful as the productivity measure for rapidly advancing industry such as telecommunications, because both the technology of production and the price of output is distorted by omitting energy, materials and purchased services. The correct (and natural) procedure is to use gross output as the output basis for productivity analysis.

The other common error in measuring telecommunications productivity is to use the wrong basis for adding up the various classes of service to get an overall measure of output. The principles of productivity require that the components of output be aggregated using marginal cost weights. There are two ways that this error is made: using revenue weights, and using internal accounting weights. The use of revenue weights amounts to assuming that marginal cost of each class of service is equal to the price charged for it, a condition that is expected to hold only in a purely competitive market for the services produced. This is a clearly unreasonable assumption; much of regulation of rates for telecommunications is directed at trying to achieve such a result, or to measure and control the deviations from it. The use of internal accounting weights to add up the various telecommunications services to a measure of total output is also incorrect. Accounting practices involve arbitrary methods for allocating fixed costs and major components of variable costs to the various service classes and are unlikely to come reasonably close to the marginal cost weights that are required by the principles of productivity measurement. In the case where multiple classes of service must be recognized, only econometric or statistical methods can produce measures of marginal cost for measuring total factor productivity and its growth.

V. Approaches in the Measurement of Productivity

A. Measurement of Productivity: Growth Accounting Approach

This section discusses the techniques for measuring the level and growth rate of TFP — output per unit of total factor input — for an industry or plant.

TFP is defined as the ratio of aggregate gross output to aggregate purchased input, with both expressed in real terms. It aggregates unlike inputs weighted by their current marginal products, and unlike outputs weighted by current year marginal costs of production. TFP is the weighted average productivity of all purchased inputs, where the weights are the shares in the total cost of production. Thus

(2) $TFP = \Sigma_j w_j y_j \ / \ \Sigma_i v_i x_i$

where y_j is the physical quantity of output j
x_i is the physical quantity of input i
w_j is the share of output j in total revenue
v_i is the share of input i in total cost
and $w_j = q_j y_j \ / \ \Sigma_j q_j y_j$
$v_i = p_i x_i \ / \ \Sigma_i p_i x_i$
where q_j = the price of output j $j = 1,\ldots,J$
p_i = the price of input i $i = 1,\ldots,I$.

The enterprise is assumed to maximize profits subject to the constraint of the production function

$$(y_1,\ldots,y_J) = F(x_1,\ldots,x_I)$$

where profits are given by

$$\pi = \Sigma q_j y_j - \Sigma p_i x_i.$$

The equilibrium condition is that economic profits are zero; hence

$$\Sigma q_j y_j = \Sigma p_i x_i.$$

That is, total revenues are equal to the total cost of production.

The equality between total costs and total revenues is insured by the assumption that all inputs are purchased in competitive markets so that their prices are equal to their marginal revenue products. All outputs are produced under conditions of constant returns to scale, and the price of output j is equal to its marginal cost. All inputs are adjusted to their equilibrium levels.

Competitive conditions in the output market do not hold in the case where prices are determined in a regulatory process. Because the enterprise is required to meet demand effective at the regulated prices, revenue weights based on administered prices are inappropriate for the construction of an output aggregate since the relationship q_j(price) = mc_j(marginal costs) does not hold. Fisher and Shell (1972) have demonstrated that the appropriate weights for output aggregation to measure the real output of a producing establishment, industry or enterprise are the respective marginal costs of producing each output. Where q_j is not equal to mc_j, we may specify an appropriate approximation to a cost function as discussed in Section III.B below and estimate that cost function. The marginal costs, mc_j, of producing each output y_j may then be determined from the estimated cost function. The resulting real output measure for a firm or an industry is thus

(3) $y_R = \Sigma_j mc_j y_j$.

This technique has been used by Caves, Christensen and Swanson (1980) for U.S. railroads; Gollop and Roberts (1981) for U.S. electric power generation; Denny, Fuss and Waverman (1981) for Canadian telecommunications; and Norsworthy and Jang (1989) for the U.S. Postal Service. An "appropriate" aggregation of outputs by using the estimated marginal costs as the weights through an econometric model would result in a better measurement of TFP and a basis of output grouping for "baskets" in the telecommunications price cap regulation.[11]

Unmeasured quality change in an input or output is another important factor in productivity measurement. If this unmeasured quality change is ignored, then its quantity will be misstated, and the TFP measure will be correspondingly biased. An unmeasured increase in the quality of an input will result in a downward bias in measured TFP. Similarly, an unmeasured increase in the quality of an output will result in an upward bias unmeasured TFP.

Determination of quality for inputs and outputs is part of the deflation process. It involves the separation of changes in the value of a good or service into price or quantity components, based on the characteristics of that good or service. For particular goods or services, small changes in quality can be fairly reliably determined on the basis of small changes in performance characteristics. At any particular time, the characteristics most closely related to performance of a particular good are usually easy to identify. However, when there is rapid technological change, quality differences are harder to measure.

The rapid technological changes in the last two decades have made the task of price deflation more difficult in consumer goods and producer goods, while the resources available to the cognizant statistical agencies — primarily the Bureau of Labor Statistics in the U.S. — to carry out the studies have not increased commensurately. Consequently, reasonably defensible measures of TFP for telecommunications will require some supporting studies of quality change in major inputs used by that industry, most notably switching equipment, microwave and fiber optic transmission devices.

For purposes of definition, the growth of TFP is equal to the aggregate rate of growth of output less the aggregate rate of growth of inputs.

$$(4)\quad \frac{dTFP}{dt} = \Sigma_j w_j \frac{dy_j}{dt} - \Sigma_i v_i \frac{dx_i}{dt}.$$

Equivalently, it can be shown that

$$(5)\quad \frac{dTFP}{dt} = \Sigma_i v_i \frac{dp_i}{dt} - \Sigma_j w_j \frac{dq_j}{dt}.$$

That is, the growth of TFP is equal to the average rate of growth of input prices less the average rate of growth of output prices. These two measures, properly executed, give identical results. Making both computations provides a partial check in the calculation procedures.

B. Using Information from an Econometric Model in Growth Accounting

The structure of production for a firm or an industry can be examined by estimating a cost function or production function. For example, a typical cost function can be defined as

$$(6)\quad TC = f(P_k, P_l, P_e, P_m; y_1, y_2, \ldots, y_J)$$

where P_i is the price of input i; i = K, L, E, M representing capital services K; hours of labor L; energy E; materials M and the level of gross output y_j, j = 1....J. For given output quantity and the given input prices, a firm is assumed to minimize its total production costs, TC. The functional forms of a cost function as models of production can be specified either as simple as a log-linear functional form[12] or as complicated as a second-order or higher order nonlinear functional form.[13] The choice of functional form ultimately depends on the characteristics of production for the firm or the industry which is studied.

From the estimation of a cost function for a firm or an industry, its marginal costs and economies of scale can be computed. The marginal costs of output y_j can be estimated by

$$(7)\quad MC_j = \delta TC / \delta y_j \qquad j = 1.....J.$$

The estimated marginal costs of outputs are used as the weights of output aggregation in the computation of TFP growth.

Since the scale elasticity is identical to the reciprocal of the elasticity of cost with respect to output (Hanoch, 1975), we use the latter as a measure of economies of scale. The scale elasticity of an estimated cost function is therefore:

$$(8)\quad SE = (\delta \ln TC / \delta \ln Y)^{-1}.$$

Important sources of growth in TFP such as economies of scale cannot be derived without using econometric techniques. Econometric models can lead to estimates of these effects, however, which can then be incorporated in the growth accounting framework by partitioning the TFP growth term:

$$\Delta TFP_R = \Delta TFP - \Delta TFP_{SE}.$$

Then the equation for output growth may be rewritten

$$(9)\quad \Delta Y = \Sigma_i v_i \Delta X + \Delta TFP_{SE} + \Delta TFP_R.$$

That is, output growth is "explained" in terms of the growth in inputs, scale effects (ΔTFP_{SE}), and residual or unexplained growth in TFP (ΔTFP_R).

Equation (9) also illustrates a most important principle of productivity measurement and growth accounting: TFP growth is normally measured as a residual after the effects of other factors have been accounted for. This fact can lead to confusion, especially when one compares the results of different investigators.

VI. Resolving Marginal Costs Into Input Price and Productivity Components

The marginal cost of each service class and of network services can be expressed as the sum of the cost of each input factor per unit of output called unit factor cost. That is, marginal cost can be partitioned into contributions from each input category. These cost contributions from each input sum up to the marginal cost of the class of service. This idea is illustrated in the relationship

$$\text{marginal cost of service} = \text{unit capital cost} + \text{unit labor cost} + \text{unit materials cost}$$

Each of these unit factor costs can in turn be separated into a physical or productivity-related component, called unit factor requirement, and the price of that input. That is, for the labor input,

unit labor = labor requirement × price of labor
cost per unit of service

and so on for other inputs. Notice that the unit labor requirement is just the inverse of labor productivity for that particular class of service. Consequently, labor productivity gains will be reflected in reduced unit labor requirements, and carried forward to reduced unit labor costs. This analytic approach can be extremely useful in studying both the levels and changes in marginal costs for each service class and for the network. To illustrate the usefulness of this concept in analyzing cost trends, an example is used from a manufacturing sector. The illustration resolves changes in marginal cost into contributions from each of the inputs: capital, labor, energy, materials and purchased services. These results are shown in Table 1.

The single input productivity and price changes that give rise to the marginal cost changes in Table 1 are shown in Tables 2 and 3 respectively. When price and productivity changes take place simultaneously there are also interaction effects, shown in Table 4.

This information can be extremely useful in identifying the sources of changes in marginal costs of individual service classes, and, properly weighted, for telephone services as a whole. A brief discussion of the information in these tables demonstrates some of their uses.

Table 1 shows, first, that the marginal cost of output rose much faster on average in 1973-79 than in 1979-86, 46.2% vs. 12.1%. Materials and labor costs were the major contributors to the overall change in marginal cost in both periods. Table 2 shows that most of these effects come from increases in input prices; in fact productivity effects were negative during the first period for all inputs. During the second period, prices rose

Table 1. Changes in Marginal Cost, Due to Changes in Unit Factor Costs

	Capital	Labor	Energy	Materials	Services	Marginal Costs
1973-79	0.040	0.108	0.034	0.184	0.020	0.385
1979-86	-0.024	0.051	0.017	0.042	0.018	0.104

Table 2. Marginal Cost Changes Due to Changes in Input Prices by Input: Average Annual Rates of Change

	Capital	Labor	Energy	Materials	Services	Marginal Costs
1973-79	0.028	0.107	0.032	0.126	0.011	0.304
1979-86	-0.045	0.068	0.024	0.069	0.017	0.134

Table 3. Marginal Cost Changes Due to Changes in Productivity by Input: Average Annual Rates of Change

	Capital	Labor	Energy	Materials	Services	Marginal Costs
1973-79	0.019	0.001	0.002	0.056	0.008	0.086
1979-86	0.045	-0.016	-0.007	-0.026	0.000	-0.003

Table 4. Marginal Cost Changes Due to Interactions of Input Prices and Input Productivity: Average Annual Rates of Change

	Capital	Labor	Energy	Materials	Services	Marginal Costs
1973-79	-0.008	0.000	0.000	0.001	0.001	-0.005
1979-86	-0.025	-0.001	-0.000	-0.002	0.000	-0.027

much more slowly, and the unit capital cost of the output actually declined (Table 1). The source of that decline is the decline in the price of capital input (Table 2) coupled with the large interaction between prices and productivity shown in Table 4. There were productivity gains for labor, energy and materials inputs in 1978-86, but these were more than offset by price increases.

VII. Conclusions

In the price cap formula adopted by the FCC to set up the price ceiling for AT&T and the LECs, productivity is one of the major factors to offset the production costs. After reviewing the FCC's determination of productivity factor, several problems in using productivity in the price cap are indicated and discussed. In the FCC's proposal, the productivity of the LECs is measured indirectly by two approaches: (1) output price difference approach and (2) "break-even" productivity approach. These two approaches are based on unreasonable assumptions. Several previous studies in AT&T productivity, reviewed by the FCC for price cap regulation, used a direct measurement of productivity. Although the direct approach is superior to an indirect approach, the FCC's method is still flawed because it ignores the adjustments for quality change of inputs and outputs due to rapid technological change. Therefore, the productivity measures from these studies are biased. In this paper we illustrate the concepts and measurement of productivity by growth accounting approach and econometric approach, and discuss cost function estimation for developing a quality-adjusted price index for productivity measurement. A reasonable and acceptable productivity growth rate to be used in the price cap formula for the telecommunications service industry should be computed by direct measurement from operating data with an quality-adjusted measurement of the prices and quantity of the inputs and outputs.

FOOTNOTES

(1). See FCC Second Further Notice at 5.

(2). See FCC Second Further Notice, 4 FCC Rcd at 2931.

(3). Not all LECs will be eligible to participate. Only the eight largest LECs - the seven Regional Bell Operating Companies (RBOCs) and General Telephone and Telegraph Company (GTOC) will be required to participate. Price cap regulation will be optional for mid-sized and smaller LECs.

(4). This is why the productivity factor is reduced by subtracting growth in a price index in the price cap formula.

(5). 1.9 percent in AT&T's own study for the years 1947-78; 4.09 percent in Nadiri & Schankerman (1981) for the years 1947-76; 2.2 percent in the American Productivity and Quality Center for the years 1948-85; 2.48 percent in the FCC's study for the post-divestiture period and 3.35 percent in Denny, Fuss and Waverman (1981) for Canadian Telecommunications. (The American Productivity and Quality Center's estimate bases productivity measurement on value added rather than gross output.)

(6). See the FCC Second Further Notice at 106.

(7). i.e. the FCC so called "long term historical productivity study" by its staff T.C. Spavins and J.M. Lande. See Appendix D in the FCC Supplemental Notice of Proposed Rulemaking and Appendix D in the FCC Second Report and Order.

(8). i.e. the FCC so called "short term historical productivity study" by its staff J.C. Frentrup and M.I. Uretsky. See Appendix C in the FCC Supplemental Notice of Proposed Rulemaking and Appendix C in the FCC Second Report and Order.

(9). See the FCC Second Report and Order at 36-46.

(10). See Jang and Norsworthy (1988a) and Norsworthy and Jang (1991).

(11). It is discussed in more detail in Section V.

(12). For example, a Cobb-Douglas production function is a log-linear functional form specified as $Y = K^a + L^b$ (or $\ln Y = a * \ln K + b * \ln L$).

(13). For example, the translog cost function is generally considered to be a second-order approximation to a function where exact form is unknown. The translog cost function can be specified as

$$\begin{aligned} \ln TC = {} & a_o + a_Y \ln Y + 1/2\ a_{YY} \ln Y^2 \\ & + \Sigma_i b_i \ln P_i + 1/2\ \Sigma_i \Sigma_j b_{ij} \ln P_i \ln P_j \\ & + \Sigma_i c_{iY} \ln P_i \ln Y \end{aligned}$$

REFERENCES

Averch, H. and Johnson, L.L. (1962), "Behavior of the Firm Under Regulatory Constraint," American Economic Review, Vol. 52, pp. 1052-1069.

Denny, M., Fuss, M. and Waverman, L. (1981), "The Measurement and Interpretation of Total Factor Productivity in Regulated Industries, with an Application to Canadian Telecommunication," in Cowing, T.G. and Stevenson, R.E. eds., Productivity Measurement in Regulated Industries, Academic Press.

Federal Communications Commissions (1989), Policy and Rules Concerning Rates for Dominant Carriers, Report and Order and Second Further Notice of Proposed Rulemaking, CC Docket No. 87-313, 4 FCC Rcd 2873 and Erratum, 4 FCC Rcd 3379 (together Second Further Notice.)

________________ (1990), Policy and Rules Concerning Rates for Dominant Carriers, Supplemental Notice of Proposed Rulemaking, CC Docket No. 87-313, 5 FCC Rcd at 2176 (Supplemental Notice).

________________ (1990), Policy and Rules Concerning Rates for Dominant Carriers, Second Report and Order, CC Docket No. 87-313, FCC 90-314 38006.

Jang, S.L. and Norsworthy, J.R. (1988a), "Productivity Growth, Technological Change, and the Structure of Production in the U.S. Computer Industry: 1959-81," working paper, Center for Science and Technology Policy, R.P.I.

__________ and __________ (1988b), "Technological Change, Learning Curves and Downstream Productivity Growth: A Study of the Microelectronic and Computer Industries," working paper, Center for Science and Technology Policy, R.P.I.

__________ and __________ (1990), "Technological Change, Obsolescence, and Depreciation in Telecommunications Services under Different Regulatory Regimes," presented and published in the Conference Proceedings of 12th Annual Pacific Telecommunications Conference, Jan. 1990 at Hawaii.

__________, __________ and Fauntleroy, P.A. (1990), "Problems in Applying Productivity Measurement to Price Cap Regulation of Telecommunications Services," presented and to be published in the Conference Proceedings of 7th NARUC Biennial Regulatory Information Conference, Columbus, Ohio, Sept. 12-14, 1990.

Jorgenson, D.W. and Griliches Z. (1967), "The Explanation of Productivity Change," Review of Economic Studies, pp.249-82.

______________, Gollop F.M. and Fraumeni, B.M. (1987), Productivity and U.S. Economic Growth, Harvard University Press.

Mathios, A.D. and Rogers, R.P. (1989), "The Impact of Alternative Forms of State Regulation of AT&T on Direct-Dial, Long-Distance Telephone Rates," Rand Journal of Economics, Vol. 20, No.3, pp. 437-453.

Nadiri, M.I. and Schankerman, M. (1981), "The Structure of Production, Technological Change, and the Rate of Growth of Total Factor Productivity in the U.S. Bell System," in Cowing, T.G. and Stevenson, R.E. eds., Productivity Measurement in Regulated Industries, Academic Press.

Norsworthy, J.R. and Malmquist, David H. (1983), "Input Measurements and Productivity Growth in Japanese and U.S.Manufacturing," American Economic Review, 73(5), pp. 947-967.

______________ (1984), "Growth Accounting and Productivity Measurement," Review of Income and Wealth, pp. 309-29.

______________ and Zabala, C.A. (1985), "Effects of Worker Attitudes on Production Costs and the Value of Capital-Input," The Economic Journal, 95, pp. 992-1002.

______________ and Show-Ling Jang (1989), "Productivity, Costs and Worker Behavior in the U.S. Postal Service," Technical Report No. 06-88, Center for Science and Technology Policy, R.P.I.

______________ and ______________ (1990a), "Cost Function Estimation of Quality Change Embodied in Inputs: The Use of Semiconductors in Computers and Telecommunications Equipment," presented in Conference on Research in Income and Wealth, NBER, Workshop on Price Measurements and Their Uses in March 1990 at Washington D.C. and to be published in its conference volume.

______________ and ______________ (1990b), "Measuring Product-Specific Markup, Marginal Cost and Return to Capital in the Multiproduct Regulated Enterprise," presented in the Seventh NARUC Biennial Regulatory Information Conference, Columbus, Ohio, Sept., 1990 and to be published in the conference proceedings.

______________ and ______________ (1991), Empirical Measurement and Analysis of Productivity and Technological Change: Applications in High Technology and Service Industries, forthcoming, North-Holland.

Rosanne Cole et al. (1986), "Quality-Adjusted Price Indexes for Computer Processors and Selected Peripheral Equipment," Survey of Current Business, Vol. 66, pp. 41-50, Jan.

Triplett, J.E. (1989), "Price and Technological Change in a Capital Good: A Survey of Research on Computers" in D. Jorgenson and R. Landau, eds. Technology and Capital Formation, MIT Press.

DIGITAL THIN ROUTE OPTIONS VIA INTELSAT

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ABSTRACT

The majority of countries that have implemented International Digital Route (IDR) systems have done so with the incorporation of Digital Circuit Multiplication Equipment (DCME) to obtain in excess of 4 to 1 multiplication. Those countries implementing the above configurations are likely to have a large need for international circuits. There are, however, several countries that desire to implement this highly efficient IDR system but have lesser traffic requirements that may prove uneconomical or costly utilizing DCME. Several options are available to these countries that require digital implementation while at the same time provide a viable economic and technical approach.

1.0 INTRODUCTION

International Digital Route (IDR) transmissions are anticipated to become one of the major service offerings of the INTELSAT network in the very near future due to the continuous growth of domestic digital facilities and the development of digital circuit multiplication equipment (DCME) which provides increased efficiencies for international telecommunication services. With the exception of Single Channel Per Carrier (SCPC)/Single Channel Per Carrier Multiple Access Demand Assignment Equipment (SPADE) and Time Division Multiple Access (TDMA) services, analog FM/FDM transmission technology was mainly used in the INTELSAT system until 1984.

Due to the rapid introduction of digital techniques in the domestic telephone switching and terrestrial networks, INTELSAT introduced the digital equivalent of FM/FDM service, namely IDR, in 1984 to provide for the interconnection of these domestic digital networks. IDR service performance is compatible with international ISDN standards and it provides high quality digital communications with information rates from 64kbps up to 44.736mbps between a variety of earth station standards.

2.0 CURRENT INTELSAT NETWORK

Since the introduction of IDR service by INTELSAT, most of the countries with new digital switching and terrestrial facilities have also converted their international transmission from FM/FDM carriers to IDR carriers and incorporated Digital Circuit Multiplication Systems (DCMS). In order to convert successfully from the existing analog FM/FDM carriers to IDR carriers, each earth station operator should investigate the necessary modifications required for the earth station equipment as well as interfaces with the terrestrial network. The normal modifications will involve the replacement of the existing analog FM/FDM multiplexer and GCE (Ground Communication Equipment - exciters and receivers) with digital modems and multiplexers. In addition, the existing Up and Down converters and HPAs should be checked for the necessary phase noise performance to ensure overall end-to-end service quality.

Network efficiency for IDR transmission can be further optimized with the incorporation of DCMS/DCME. The existing DCMS used in the INTELSAT network was initially developed in the 1984-1985 time frame and uses its own proprietary algorithms with no requirements for multi-destination connectivity. DCMS has been readily available in the market and can be used on high density routes in the INTELSAT system. Subsequently, INTELSAT introduced the IESS-501 DCME specification with its own defined algorithm, multi-cliques and multi-destination requirements. In order to identify between the two systems, the INTELSAT open network unit is called the DCME and the private closed network units are called DCMS.

Both the INTELSAT DCME and the proprietary DCMS systems adopted techniques which employ a combination of Digital Speech Interpolation (DSI) and Adaptive Differential Pulse Code Modulation (ADPCM). DSI takes advantage of the silence intervals built into telephone conversation for the transmission of speech samples of active talkers. ADPCM reduces the number of bits necessary for the speech samples from 8 to a lower value (nominally, an average value of 4).

When the original DCMS specification was developed, it was mainly written for high density applications and did not take into consideration the unexpected sharp increase in Group 3 Facsimile (FAX) traffic nor the growing requirements for thin route applications. The INTELSAT DCME specification incorporated the multi-cliques and multi-destination requirements coupled with the lower transmission rate of 512 kbps for thin route applications. However, the high demand of Group 3 FAX traffic continues to limit the efficiency of IDR service until a more efficient algorithm for FAX demodulater/remodulater is developed and incorporated into the system.

Figure 1 illustrates the migration of existing analog circuits to the digital network and shows that digital conversion is increasing rapidly in both the Atlantic Ocean Region (AOR) and Pacific Ocean Region (POR). Full conversion is exptected by 1994. Specifically, (as shown in Figure 2), the POR forecast indicates strong digital conversion through 1991. From this point in time, the medium and high density routes would all be converted into IDR/DCMS operation, with some residual FM/FDM traffic remaining in the system unless these thin routes are also converted to digital transmission using one of the approaches suggested in the next section.

FIGURE 1 - PERCENT DIGITAL BY REGION
GTM - 1990 US TO WORLD

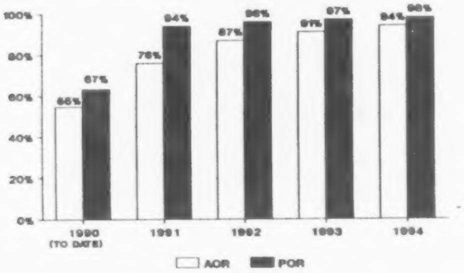
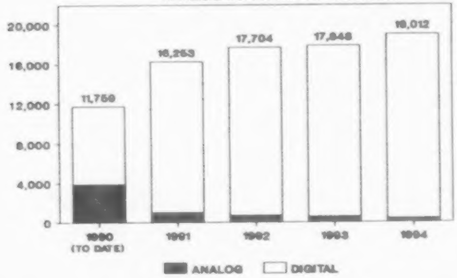


FIGURE 2 -- GTM - 1990 FTVG FORECAST
ANALOG VS. DIGITAL IN THE POR



Presently, 34 of the major operators within the AOR utilize IDR with DCMS which represent 28% of the AOR countries. Meanwhile, the major POR operators, including Hong Kong, Japan, Australia, and Singapore, have also recently committed to accelerate their IDR implementation. It is clear that most of the large users in both ocean regions have already established viable IDR/DCMS services, and they are awaiting the smaller users to join them in the near future.

Statistical telecommunication requirements of large users or operators with high density requirements have driven digital conversion rather than the capability or aggressiveness of the country/operator involved. Small or thin routes normally require a circuit provisioning of 10 to 30 trunk circuits. These users need an economically viable option to enter the digital world of INTELSAT.

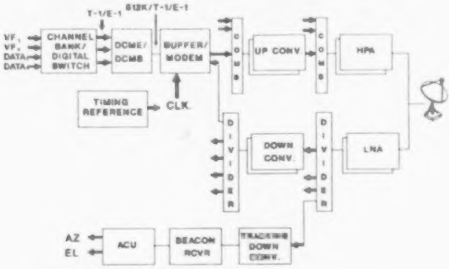
3.0 IDR FOR THIN ROUTE APPLICATIONS

Large IDR carriers (greater than or equal to 1.544/2.048mbps) combined with DCME or DCMS offer the most economical and efficient use of INTELSAT space segment. However, such advantages decrease when the number of trunk circuits in a given bearer are reduced or the size of the bearer circuit is smaller than 1.544/2.048mbps.

Most of the IDR carriers implemented today operate with 1.544/2.048mbps. This bearer capacity provides, after DCMS multiplication, a capacity of 100-150 trunk circuits. INTELSAT recognized that this traffic is too large for many links. An attractive solution for thin route is based on implementation of DCME or DCMS on bearer links smaller than 1.544/2.048mbps. In Revision 5 of the IESS-308, INTELSAT introduced a new rate of 512kbps (8 timeslots). The new specification assumes that small IDR links will be multiplied by a factor of only 2:1 by implementing Low Rate Encoding (LRE-ADPCM) transcoders. However, some of the existing DCMS manufacturers have investigated the probability of modifying the existing DCMS equipment for 512kbps operation and found that a DCMS gain of 4:1 can be achieved. In fact, some administrations have already conducted laboratory simulations and live traffic tests to verify that a 4:1 gain could be achieved with low voice band data (approximately 10%).

The capabilities and options available from each DCMS equipment manufacturer vary significantly. Therefore, the final equipment selection merits serious considerations. One of the significant advantages in using thin route DCMS is that the same equipment could be reconfigured for higher rate transmission (1.544/2.048mbps) as the traffic grows in the future. However, the initial capital investment of the DCMS remains

FIGURE 3 - IDR/DCMS CONFIGURATION


T-1/E-1
512K/T-1/E-1
VF₁
VF₂
DATA
DATA
CHANNEL BANK/ DIGITAL SWITCH
DCME/ DCMS
BUFFER/ MODEM
TIMING REFERENCE
CLK.
C O M B
UP CONV
C O M B
HPA
D I V I D E R
DOWN CONV.
D I V I D E R
LNA
AZ
EL
ACU
BEACON RCVR
TRACKING DOWN CONV.

significant for some earth station operators. (A block diagram of this configuration is shown in Figure 3.)

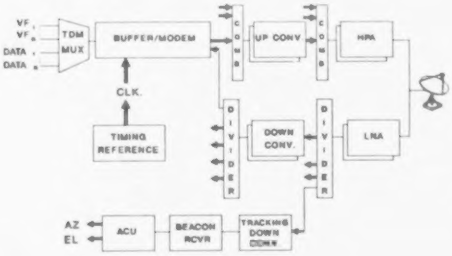
3.1 OTHER OPTIONS FOR THIN ROUTE APPLICATIONS

Other options for digital transmission in the INTELSAT system which merit consideration include the use of intelligent Time Division Multiplexers (TDM) and Low Rate Encoding (LRE).

The use of intelligent TDM has been adopted in the INTELSAT system in the IBS (International Business Service) private line network. The voice encoding techniques used vary from the use of proprietary algorithms; CVSD (Continuous Variable Slope Delta modulation) to CCITT G.721 ADPCM algorithms. Most of the TDM equipment employs only LRE without the DSI. Therefore, the system gain will be somewhat limited to approximately 2:1 or a bit higher if lower rate CVSD encoding is used. However, the network efficiency can further be improved if FAX demodulation/remodulation techniques are used to separate the FAX requirements and connect the FAX demodulated output to the data port of the TDM instead of the voice port.

Most of the TDM equipment offers expansion flexibility by using network management software to reconfigure the carrier size and by adding channel units. Moreover, the initial capital investment of a TDM terminal is much less than DCMS or even a few SCPC channel units. Most of the TDM equipment operates with proprietary protocol which require bilateral agreements. A block diagram of this configuration is shown in figure 4.

FIGURE 4 - THIN ROUTE IDR CONFIGURATION USING TDM


VF₁
VF₂
DATA₁
DATA₂
TDM MUX
BUFFER/MODEM
CLK.
TIMING REFERENCE
C O M B
UP CONV
C O M B
HPA
D I V I D E R
DOWN CONV.
D I V I D E R
LNA
AZ
EL
ACU
BEACON RCVR
TRACKING DOWN CONV.

In order to provide the flexibility for future growth, it is recommended that the modem used for this kind of application should have the variable bit rate and FEC for future transmission rate changes.

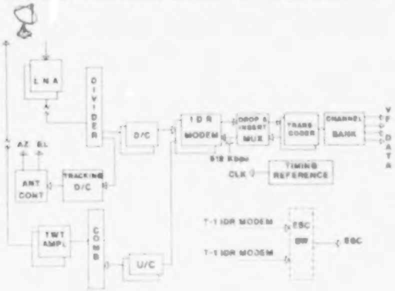
The other option for thin route IDR implementation is the use of channel banks to provide PCM encoding and then convert PCM to ADPCM by using the transcoder. Finally, a digital cross-connect or drop and insert multiplexer is used to extract the necessary bandwidth for international transmission. This approach provides the necessary low rate encoding (2:1 gain) without the option of using FAX demodulater/remodulater to improve the network efficiency. (A typical configuration for the low rate encoding technique is shown in Figure 5).

3.2 MAJOR IMPLEMENTATION CONSIDERATIONS

Some of the major considerations in determining a network configuration are the equipment cost, satellite capacity and service performance quality.

Each earth station operator should perform a cost analysis of the space segment charge and the capital investment. The analysis should take into consideration: the traffic growth

FIGURE 5 - THIN ROUTE IDR CONFIGURATION USING LRE


L N A
DIVIDER
D/C
I D R MODEM
DROP & INSERT MUX
TRANS CODER
CHANNEL BANK
V F
DATA
512 Kbps
CLK
TIMING REFERENCE
AZ
EL
ANT CONT
TRACKING D/C
TWT AMPL
COMB
U/C
T-1 IDR MODEM
T-1 IDR MODEM
ESC
SW
ESC

requirements for the next five years; the performance and the cost savings using the existing transmission technology; and one of the above IDR and/or thin route IDR approaches.

Other considerations required for successful IDR implementation are: equipment training; network interface and synchronization; equipment compatibility; test co-ordination and scheduling.

4.0 CONCLUSION

Most IDR implementation in high density routes before 1992 is anticipated to use existing proprietary DCMS equipment and will most likely remain on large, single destination IDR/DCMS carriers. In addition, 512kbps IDR with and without DCME/DCMS will become a widely acceptable approach for thin route applications. However, the other thin route options using either TDM or LRE should merit some consideration for operators who require much less than 8 timeslots or bearer circuits for their international requirements.

Telecommunications Infrastructure and Economic Development: Principles for Formulating Investment Policies

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Abstract

Telecommunications regulators or ministries must choose among alternative policies for investment in infrastructure expansion or modernization. Such choices should ideally be based upon cost-benefit analysis, but often the necessary information is not readily available. Policymakers need to develop creative means of estimating and allocating incremental costs, of allowing the marketplace to evaluate direct economic benefits, and of measuring differential indirect benefits across policy options.

1. Introduction

Telecommunications infrastructure and investment questions are prominent in economic policy debates in both the developed and the underdeveloped world, and even though the terms of discussion, the technological base, and the socioeconomic stakes involved may differ widely, there is reason to view the issues facing the industrialized world and Less Developed Countries (LDCs) from a common perspective.

In the U.S., Canada, Western Europe, and Japan, the key infrastructure issues revolve around whether, and how soon, to invest in widespread deployment of new technologies, including fiber optics, digital switching, and ISDN, to replace or enhance the existing analog and copper facilities that serve those nations on a fairly ubiquitous basis. In most of the rest of the world (including Eastern Europe, Africa, the Pacific, and Latin America including Mexico), where at present telephone facilities are available only to an elite fraction of the population, investment in telecommunications infrastructure implies, in the first instance, establishing something approaching universal basic voice telephone service. In other words, developing countries are seeking to achieve an infrastructure that is on a par with the developed world status quo, upon which industrialized nations are themselves seeking to improve.

In summary, the basic concerns raised about public policy concerning infrastructure investments in a rapidly changing technological environment are that: (1) the government planning or regulatory apparatus does not generally represent an adequate proxy for "market forces" in fostering economically efficient investment choices, but (2) at the same time, investment decisions driven solely by narrow, short term private sector incentives and economics will not tend to take into account larger societal interests in allocating scarce resources toward their most beneficial use.

Coming to grips with these conflicting problems is at the core of the challenges facing public officials charged with the responsibility to regulate or oversee telecommunications infrastructure investments.

2. The need for cost-benefit analysis

If we focus only on the anticipated advantages of improved telecommunications technology, it is difficult to disagree that almost any investment would be worthwhile in and of itself. Whether we are talking about upgrading existing networks to ultra-modern digital and fiber technology, or simply installing local central offices and loop plant in previously unserved rural villages, such investments would undeniably enhance a society's ability to communicate, and improve economic productivity and the quality of life. But the point is that such improvements are not costless and cannot be ubiquitously and instantaneously made. Other public investments, in such sectors as agriculture, public health, transportation, schools, environmental management, energy, and housing, would also bring undeniable benefits to society as a whole. Telecommunications investment policy decisions are thus dependent upon comparative evaluations of alternative choices across sectors, a process which is complicated by the fact that telecommunications serves as an input to all other sectors. But even assuming that the optimal allocation of resources across different sectors is achieved, decisions concerning investment of the resources designated for the telecommunications infrastructure also require establishing priorities among the various economic and geographic subgroups that are candidates for enhanced technology. These choices, as between urban and rural locations, and among business, residential, and government users, may be just as vital to the success of an investment program as the timing and magnitude of the overall capital outlay.

In each situation there is a need to weigh the costs of investment with the expected societal benefits, where those benefits may be far less certain and quantifiable than costs. In principle, the ideal investment policy will be that which results in the long run net societal incremental cost of investment being equal to long run net societal incremental benefit. This theoretical concept, however, is not terribly useful unless one has sufficient information with which to analyze such costs and benefits. At least three significant empirical barriers confront the policymaker:

(1) Identifying and isolating incremental investment cost may be hampered by institutionalized cross-subsidies, either within the telecommunications sector or between industries. If existing mechanisms for measuring and allocating costs do not readily distinguish between new investment in infrastructure improvement and the ongoing costs of maintaining existing service levels, or of providing other, non-telecommunications services to the public, then the "supply" side of any cost-benefit analysis will be difficult to specify.

(2) Measurement of the potential direct benefits that will flow from investment in the telecommunications infrastructure is impeded by the uncertainty of future market demand for services or capabilities previously unavailable, and by the unpredictability of exogenous macroeconomic conditions influencing businesses' and consumers' needs and purchasing power.

(3) The scope and magnitude of indirect societal and economic benefits resulting from the expansion of telecommunications are perhaps most difficult of all to evaluate, especially since long-term GNP growth or other economic effects that may be correlated with infrastructure improvements may not ever be directly traceable to any specific investment program.

Rather than reject the notion of cost-benefit analysis because of these complexities, it is important for officials considering investment options to examine them more closely, with a view to developing innovative means of at least estimating the relative magnitude of costs and benefits inherent in alternative investment programs. Following is an outline of a proposed three step approach to formulation of telecommunications sector investment policies, which responds to the inherent uncertainties of the process whose principles can be applied similarly in both developed and developing countries.

3. Step 1: Measurement and allocation of costs

Before proceeding with a cost-benefit analysis, it is necessary to divorce the investment decision process for enhancement of the telecommunications infrastructure from economic policies and business practices concerned with other aspects of the economy, or with maintaining and providing existing service levels. There is a presumption that the starting point of any investment decision can be established as a "business as usual" or Present Mode of Operation (PMO) scenario, which takes into account all costs (including incidental capital investments) necessary to sustain the present level of service for the present subscriber base. Additional investment to expand or enhance the infrastructure beyond the PMO would constitute modernization or expansion, and it is the net incremental costs of this investment that should be compared with net incremental benefits for any given option.

In a static world, the distinction between "business as usual" investments and network "modernization" would be determined by technology alone. Where older analog, electromechanical, and/or copper facilities adequately served a given customer base, further investment in such technologies would be classified as providing for growth and service maintenance, not network enhancement. New (and by assumption more expensive) technology — electronic, digital, fiber — would by definition be classified as modernization.

The difficulty is that in the real world changing technology and cost conditions often determine that the most economically efficient investment for basic growth and maintenance purposes happens to be to replace older technology with new facilities, whose installation also incidentally makes available a new set of network options at comparatively low incremental cost.

In the case of network expansion to new geographic areas, the difference between present levels of service and new investment may be fairly clear, but often in developing countries expansion means adding both switching and access line capacity to an existing network to meet excess demand. It may be difficult to decide how much expansion is needed to sustain present service quality, and at what point true service expansion begins. This distinction is important not so much for deciding how much total investment to undertake, but rather for choosing among the many alternative locations and applications for a given level of investment. Certain cities, or sections of cities, may be among the most productive economically, and the most dependent upon telecommunications; continuing to meet their needs may allow their contribution to the economy to remain undiminished, but this is not the same issue as expanding telecommunications availability to new areas and new potential businesses.

Telecommunications Ministries or regulators should be in a position to undertake the cost allocation assessments implicit in this approach, assuming they have access to adequate data on present network costs and usage. To the extent sufficient records of facility and operating costs, and of traffic demand, are not well maintained, improvement of the record keeping function must be the first priority of the decision maker. Expertise in cost analysis and allocation methodologies will also be critical to this stage of policy development, as it will be to many other areas, such as pricing policy.

4. Step 2: Measurement of direct benefits

The next tier of the analysis involves attempting to measure the direct economic benefits of investment programs, and comparing them to incremental cost. Direct benefits can be defined as benefits perceived by the marketplace, in terms of users' willingness to pay for the services and capabilities made possible by telecommunications technology. Economic theory assumes that if a customer is willing to pay a certain price for a product or service, that customer must realize a "benefit" equal to or greater than that price, and thus the total revenues that can be generated by offering new services to customers (and/or traditional services to new customers), by definition establishes a floor for the societal benefits that the investment creates.

It is important to emphasize that revenues from new service offerings should not be lumped together with potential increased revenues from existing customers and services when performing the cost-benefit analysis. The fact that price inelasticity may permit an increase in existing service rates that could, through cross-subsidy, be used to fund infrastructure enhancements does not represent a measure of the "benefits" of those enhancements. As useful as such revenues may be to funding an investment program, in an economic sense they would merely constitute a transfer of consumer surplus from present to new service customers, and not a true benefit resulting from the new investment.

The principal difficulty in evaluating direct incremental benefits of infrastructure investments is that such benefits cannot be precisely known until the investment is in place and the services are available. If the public turns out to be unwilling or unable to buy the services that new technology makes possible, it will be too late to reverse the investment program, and the carrier's costs will have to be recovered from other sources (e.g., existing price inelastic service ratepayers, capital investors or lenders, other government revenues). Projections of revenues from new services, and from offering service to previously non-connected areas, are thus critical to the investment decision process, but unfortunately these projections are by their nature dependent upon fairly limited market intelligence. Historical experience with traditional telephone services in an industrial economy is not necessarily a predictor of demand for new, unfamiliar capabilities, nor are measures of demand among a small (wealthy) elite for telephone access a reliable basis for forecasting the needs and habits of the masses in LDCs.

There are some research approaches that may help estimate demand responses. Small-scale test programs can probably establish a range of expectations for the larger market response, but that range can be quite wide, and the biases of a small sample are unpredictable. Cross-sectional analysis of known data from other countries or regions may also contribute to the process of estimating demand elasticities for untested populations. Certainly much more research along these lines is warranted, both in developing countries investigating network growth potential, and in industrial countries contemplating exotic new technologies and services.

In the end, the investment decision must often involve significant economic risks for the carrier (or government) undertaking it—risks which in competitive non-utility industries would be measured by the capital markets, in terms of bond ratings, stock prices, venture capitalists' demands, and the like. Since telephone carriers are either state-owned or regulated utility franchises, these market-based measures of risk are deflected by the assurance that the capital funds necessary to support an investment program will be recovered through other means if sufficient direct incremental subscriber revenues do not materialize. Unfortunately, without the capital markets' objective assessment of the risk of investment plans, there is no independent means of estimating investment risk, and incorporating that risk in the overall investment decision process.

The policy challenge, therefore, is to devise a mechanism whereby the implicit risks of telecommunications investment programs designed to expand the infrastructure can be properly accounted for, and compensated, in a manner analogous to private sector entrepreneurial ventures. Such a mechanism would shift the responsibility for assessing uncertain future direct revenue benefits away from the insulated carrier, and from the government, toward private, third party interests. In many instances, it may be possible to design a program that would induce private investors to evaluate the magnitude of the risks and prospective gains of alternative investments, and to actually supply investment capital (i.e., incur investment "costs") commensurate with their comparatively "objective" analysis of the market.

Private investment in the telecommunications infrastructure would be most attractive to companies whose business activities would directly benefit from improvements in telephone service. Partnership programs might be designed to allow such companies to provide capital funds in support of network expansion, in return for tax breaks, free telephone service, exclusive rights to develop value-added services, and other concessions. Arrangements could also be made for private investors to share in any long term profits generated by the new investments, or otherwise to have their funds paid back with interest by the government or telephone carrier. Of course, such programs would require the private investor to bear at least some of the risk of investment, in the event that costs exceeded expectations, revenues fell short, or other problems developed. The key point is that the direct economic benefits of enhancement and expansion of telecommunications capabilities are best evaluated by those whose training and experience is in the free marketplace, rather than government bureaucracy, and such evaluations will be most viable when private interests are in a position to share in the benefits, and the risks, of investment.

There are of course many pitfalls and unanswered issues connected with this policy direction. Government and utility planners must still establish the parameters of investment choices, in line with long term objectives that may not coincide with narrow market interests. Some investment strategies that private firms might support, for example, could yield high short term returns by concentrating on low cost, high demand markets, but these approaches could inhibit the development of a national infrastructure and exacerbate inequities among groups and regions. Some governments may wish to pursue investment in interim technologies such as cellular networks and public telephones as the quickest way to bring service to unserved rural areas, with the objective of stimulating usage and secondary economic activity; these may not be "profitable" investments appealing to third parties, but could lay the foundation for important social, economic, and political development. For these reasons, the policy calculus must move beyond direct returns on investment, and examine the elusive indirect benefits.

5. Step 3: Estimation of indirect benefits

There are two types of indirect economic benefits associated with telecommunications service, whose value will not be reflected in customers' demand patterns and willingness to pay for services. The first category is those benefits that represent true externalities, which will have only long-term, intangible economic impacts upon individual telephone service users. Expansion of universal service, for instance, theoretically benefits existing subscribers through broad-based economic growth, but in a pure free market, existing subscribers would not be expected to voluntarily subsidize the access of new subscribers. Numerous other kinds of benefits, resulting from improved education, social services, even entertainment can rightly be attributed to the telecommunications infrastructure, but private citizens cannot easily draw the connection to their own welfare. Such "public good" characteristics of telecommunications depend upon political consensus to sustain them.

A large portion of the indirect benefits, however, are not so much externalities as deferred benefits accruing specifically to end users, whose payoff may occur gradually, over many years following the implementation of new or expanded telecommunications technology. For many subscribers, especially lower income residential telephone customers, it is not realistically possible to "invest" in enhanced communications capabilities on the basis of expected future "efficiency" gains or other long-term economic returns. The likelihood and measurability of individual subscriber benefits resulting from, for example, savings on consumer purchases due to wider market access, or avoidance of superfluous transportation costs, are typically too abstract to be accounted for in short-term demand patterns. Yet these types of real economic benefits can certainly be expected from many forms of telecommunications investment, and would, in a theoretical world, justify some level of increased consumer spending to obtain the new service offerings, whether those offerings are simply basic telephone service in the first place, or advanced integrated digital connectivity.

The expectation of deferred intangible subscriber benefits, as well as purely external societal benefits, suggests that a market incentive mechanism for funding telecommunications investment projects may not be sufficient to realize the full range of economic gains from such projects. Indeed, in the case of infrastructure expansion in rural areas, for example, or large scale technological upgrades, it may turn out that market forces themselves would not be sufficiently strong to support any meaningful investment.

Thus the third challenge that policymakers must address, in addition to pursuing some degree of market-based funding mechanisms, is to identify and measure the likely extent of indirect economic benefits that additional investment might engender, and to seek appropriate subsidy, loan, and other public funding sources to achieve the optimum investment strategy. Reasonably credible estimation of indirect economic benefits is critical at this stage for several reasons. Most important, a meaningful sense of the expected long term payoff of alternative investment approaches will help policymakers to determine the ideal deployment of limited resources. In many cases, the availability of investment funds from international financing agencies such as the World Bank may be partly dependent upon thorough analysis of the likely economic impact of an investment program. Even in developed countries, competition for investment capital between industries, and regulators' concerns about prudent utility investment, imply that a clear, supportable demonstration of the net positive impact upon the economy of large scale network enhancement strategies would be far more viable than unsubstantiated assertions of an open-ended "need" to upgrade technology.

Of course, the difficult question is how to go about valuing uncertain future indirect benefits. Some researchers have addressed this question from both macroeconomic modeling and microeconomic empirical perspectives. The key requirements, before attempting to quantify benefits, are to establish the terms of the alternative investment decisions that are available. Choices between investment in telecommunications at all, as opposed to other sectors of the economy, will present the greatest complexities when attempting to compare long term paybacks, and will likely require some combination of macroeconomic (e.g., input-output) modeling and informed guesswork (as well as political realism) to arrive at a decision.

Investment choices within the telecommunications sector, such as between urban and rural locations, switching and access technology, and business and residential service, may be based upon more empirical analysis. Studies of existing traffic patterns, revenue flows, employment and output data, and a variety of other factors, can suggest areas where improvement of telephone service access and quality will most rapidly and efficiently allow businesses and consumers improve their productivity, and spur broad-based growth opportunities.

Of course, to the extent social policy goals, such as achieving connectivity in poor rural areas, may outweigh certain economic objectives, governments may wish to choose a less than optimally "efficient" investment path. Even in these situations, however, knowledge of the magnitude of the tradeoffs involved will be valuable in the policy development process.

POLICY CHALLENGES IN THE EVOLUTION OF THE WORLDWIDE PUBLIC TELECOMMUNICATIONS NETWORK

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1. ABSTRACT

The paper is aimed at identifying the inevitable public policy problems that are and will continue to emerge from the evolution and adaptation of technology useful for fulfilling information needs of people. Information, in this sense, includes both the manipulation (data processing), as well as the transportation (telecommunications) of content. All governments worldwide are and will be faced with significant policy issue decisions. The purpose of the paper is to identify why these policy issues will arise, as well as to suggest potential ways that these policy issues should be resolved, including the underlying societal rationale for following the solutions suggested.

The theme of PTC - 1991 is Accessing the Global Network. There are two fundamentally different ways to think about this theme. First, the theme could be interpreted as making a basic global telecommunications network uniformly and universally available throughout the world. By pursuing that path, we could discuss issues of international bank financing, differential accounting rate retention by LDCs, privatization, etc. That path is one that has had a lot of concentration in the past few years. That is not to say that many viable answers have been generated, but that dialogue will continue.

A second theme interpretation could be oriented around the evolution of the worldwide public network from a basic voice-grade transporter of information to a network characterized as having state-of-the-art, intelligent technologies with a broad array of feature rich attributes.

In my mind, the reality is a little of both themes. LDCs will be working very hard to deploy a basic telecommunications system to ever greater percentages of their populations while the more highly developed countries will be pursuing evolution of their networks to advanced, intelligent levels.

This means that, from a policy perspective, both issues will need to be addressed simultaneously. It is my intention to limit my remarks to the second theme, that of addressing those public policy issues related to the evolution of the public network to an advanced intelligent level.

As a prelude to directly talking about that issue I would first like to lay some groundwork.

The challenges and opportunities for the telecommunications and information handling businesses are taking place in a unique environment created by the confluence of two separate businesses that are becoming one. The uniqueness comes from the historical nature of each business. Telecommunications, whether governmentally or privately owned, has a history of fulfilling certain governmentally defined societal objectives while carrying out its business functions. A heavy government policy direction via full economic regulation is the historical basis of the telecommunications business.

The information handling business, however, has a history of full marketplace competition from its inception. As these two formerly separate businesses become more integrated, governments have one of two basic policy options:

1) Extend regulation at the margin to eventually encompass all these related business activities under full economic regulation by government; or

2) Withdraw regulation at the margin to eventually encompass none of these business activities under full economic regulation.

The trend in the world is to follow the latter course. With that environmental context covered, we should return to the question of opportunities and challenges in this major and growing sector of all our economies.

The opportunities are obvious
- there is a long term growth in worldwide demand for the activities we perform
- there are long term reductions in costs for performing these activities
- The activities we undertake do not pollute the atmosphere

It is the challenges that I believe will become more difficult and larger. We need to put these challenges in the context of some fundamental assumptions. The first assumption is that the ever increasing globalization of business activity requires an intelligent, feature-rich public network system worldwide. This is a requirement even for the largest multi-national firm. This is a requirement even for the smallest, least developed country, if that country ever hopes to become developed.

The second assumption is that the institutional framework for guiding the evolution of the public network system on a worldwide basis is inadequate. I am referring to the institutional framework for the business decision process that decides what the nature and characteristics of an evolved public network system should be.

The third assumption is that the nature of future technology, taken together with its economics of deployment, requires a much higher level of interworking and interoperability between all of the parts of the public network system than historically.

With these assumptions as a backdrop, how will the 170 countries of the world evolve the public network system to a state of intelligence and feature-functions that will be required? How will these countries collectively create conditions which allow a reasonable opportunity for meeting this challenge?

Use of a United States example may be useful.

- the U.S. has 1,300 telephone companies, each with its own sovereign (franchised) territory.

- a few of these companies are relatively large (7 Regional Bell Operating Companies and GTE each have about 13 million access lines), with generally rich economies in their operating areas.

- about 1,200 of the companies are small, 15,000 access lines or less, many who serve areas that lack strong underlying economies.

- due to the economics of future technologies, many of these smaller companies lack sufficient economies of scale and scope to deploy network systems that are economically self-sufficient.

I will use two examples to help make this point

1) at currently forecasted levels of use, a signaling system number 7 (SS#7) and related intelligent data bases require about 6.5 million access lines coverage to become economical.

2) an intelligent information gateway that allows information service suppliers reasonable access to customers requires about 6.5 million access line coverage to be economical. Therefore, in order to participate in an advanced capability, intelligent public network system, smaller and medium sized companies need to either band together or become dependent on neighboring larger companies for intelligent, advanced public network features.

Transferring my U.S. telephone company analogy to a country basis in worldwide network, the following implications arise:

1) Smaller countries with lesser economies and fewer telephone access lines will need to become vastly more interdependent with other country public network systems if they are to have sufficient economies of scale and scope to support further development of their telecommunications network. Attempts to "go it alone" without sufficient economics of deploying advanced technologies will cause their prices to be too high relative to alternatives.

2) The institutional framework for making overall network evolution decisions and intercountry network deployment decisions does not exist. Such institutional frameworks will need to be created if there is to be rationality in the evolution.

3) If the public network system does not evolve fast enough, private networks of multi-national firms (of ever decreasing size) will serve their advanced network needs.

These uses may never come back to the public network.

Even with these significant challenges, I believe that the combination of our opportunities and the long term view of those providing public networks worldwide will allow us to adequately overcome the challenges.

CREATING A PERSONAL RADIO SERVICE IN THE U.S.
NAVIGATING THE STORMY REGULATORY SEAS

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1. Abstract

The Federal Communications Commission has embarked on a broad inquiry designed, ultimately, to assure the domestic availability of ubiquitous personal communications services. The administrative processes which will be followed by the FCC assure that this will be a highly charged and long term project. This paper will study the regulatory procedures which will occur in any spectrum allocation proceeding undertaken, and then review past decisions of the FCC in implementing mobile services, to consider potential approaches to the creation and regulation of any PCN services which may be authorized by the FCC at the end of its inquiry.

Perhaps no communications-related advances conjure up more vivid images to the typical consumer than the "wireless communicator". Technology advances in the 80's have given most consumers empirical evidence of the benefits of wireless communications -- whereas "radio" communicators were once the province of police departments, truck drivers and taxi cabs, advances in paging, air-to-ground, and cellular technologies have provided many consumers with a variety of opportunities to use, and realize the substantial benefits of, communications mobility.

This mobile communications explosion domestically has been further affected by the democratization and industrialization of Eastern Europe and many of the South American countries. Societal changes in these regions have spurred increased interest in mobile communications systems, which are seen as providing the greatest potential for introducing advanced communications capabilities to societies which, even today, have only an elementary and antiquated wired telephone network.

In many respects, then, as societies become more mobile, and less oriented to particular fixed locations for particular lifestyle functions, the need to provide a low cost, user friendly, mobile means of communicating -- to cut the umbilical cord of the communications medium -- becomes even more critical to the societal advance. The pressures on technologists to develop such systems, and on the regulatory agencies -- the Federal Communications Commission ("FCC"), the National Telecommunications Industry Association ("NTIA"), and probably even Congress -- to allocate spectrum and develop the regulations necessary to encourage such technology, will be substantial.

It is virtually a given that technologists will be able to improve upon today's wireless capabilities to create better, smaller, more powerful wireless networks and systems which will continue to attract consumer interest. Indeed, the increasing demand for more communications mobility virtually assures that technology will achieve such advances. That industry today refers no longer to "cordless" communications, but rather to "tetherless" systems -- in order to further establish that no relationship will exist between a "telephone" and a particular base station -- proves how far the concepts have developed even over the last few months. However, the ability to achieve wireless advances in the United States will necessarily depend upon the availability of radio spectrum allocations and implementing regulations.

In this paper, I will explore the state of regulation in the wireless information arena in the United States. Agter considering the fundamental procedures which will be followed in acheiving the requisite administrative actions, I will look both at the past decisions of the FCC and at its current activities in allocating spectrum and setting technical and licensing standards for mobile communications networks. I will then discuss the principal proceeding in which future decisions on wireless networks is likely to be made, the issues likely to be addressed in that proceeding, the major sectors likely to be involved in the regulatory fray, and likely timetables for decisionmaking. Taking note of the results achieved from past efforts -- and the impacts (both positive and negative) they have had on advancing the state of technology -- I will postulate and weigh the benefits of potential regulatory approaches to be followed if the United States is to achieve the regulatory environment necessary to advance, and indeed play a leading role in the development of, future wireless technologies and information networks.

Any discussion of regulation and technology in the wireless communications arena must, however, begin with a caveat. Like the state of technology, the state of regulation in this area is highly dynamic. Virtually every week a new market entrant with a new idea or approach to providing wireless communications enters the fray. The technological solutions and spectrum demands needed to satisfy each new market entrant may be quite different. Nevertheless, each of these proposals is likely to face a significant and difficult regulatory battle, first in finding the necessary radio spectrum, and then in obtaining the requisite licenses and franchises to provide the service. While technologists try to improve spectral efficiency, expand capabilities and decrease the costs of various services, the regulator must continue to balance the resulting, and often competing, demands for spectrum from the various proponents of the services and products which result from the technologists successes.

The FCC is continually faced with demands to increase the spectrum available for wireless telecommunications, at the same time that it faces demands for spectrum for new forms of mass media distribution and to meet the increased demands of existing service providers for spectrum to meet their own growth projections -- the Hobson's choice which regularly faces those who are charged with assessing competing demands for limited resources. The job of the FCC, then, is to incent both new users and old to improve spectral efficiency through technology, and ultimately to choose those technologies and services by which the maximum number of users and uses can be made of the radio spectrum for purposes that cannot be satisfied through some wired technology. And it must then reward those who have developed new technologies with the opportunity to implement them, at the same time that it creates the competitive environment in which services are likely to be presented to the consumer at the lowest cost and highest quality.

Spectrum Allocation

Because one party's use of radio spectrum has the potential for interfering with another's, the radio spectrum has long been allocated among potential users, both internationally and domestically, by the governments of the world. As a starting point, spectrum allocation is, quite logically, an international matter, since radiowaves do not stop at the border of a given nation. Under the auspices of the International Telecommunications Union ("ITU"), the nations of the world divide the use of the spectrum among three different regions -- Europe and Africa (Region 1), North and South America (Region 2) and Asia and the Pacific countries (Region 3). Having received the world's intended frequency allocation scheme -- which is regularly renegotiated at world wide and regional administrative conferences -- the FCC and the NTIA divide up the spectrum between the government and private sectors. Some spectrum is typically allocated exclusively to either side, while a limited amount of spectrum is made available on a shared basis -- primary to one side, but also available on a secondary, non-interfering basis to the other. An Interdepartmental Radio Advisory Committee, representing the NTIA and its constituent agencies and the FCC coordinates such shared uses.

The FCC's decisions on allocating the spectrum reserved for the private sector are governed by the provisions of the Administrative Procedures Act, which require that decisions on spectrum allocation be made only after notice of an intended decision -- and an opportunity to comment -- has been given to the public. In today's highly charged, spectrum scarce environment, it is reasonably certain that any effort to create new uses of, or to reallocate, any part of the spectrum will invite substantial debate from a wide variety of interest groups intent on protecting what they have today or what they anticipate needing in the future.

There are many vehicles for presenting requests for spectrum allocations to the Commission. Often the developer of new technologies or special interest groups will file a petition for rulemaking, providing a specific proposal to the Commission for new regulations designed to effect particular uses of the spectrum. In other instances, technology breakthroughs are the result of experimental or developmental licenses issued to spectrum pioneers. When those efforts bear fruit that requires a spectrum allocation, a proceeding may be started to effect the requisite allocation. In some cases, counterproposals in one proceeding which cannot reasonably be satisfied in that case may lead to the initiation of a distinct proceeding designed to satisfy the needs of the counter-proponent.

Sometimes the Commission is faced with new ideas or developments, but the record on them is so sparse or contradictory that the FCC is not yet sure what to propose in a rulemaking notice. In those cases, it may instead initiate its consideration with a Notice of Inquiry, in which it will pose a series of questions for public comment, often about the state of technology, the potential demand for competing proposals, alternatives available for meeting those demands, and similar general questions designed to elicit broad based responses on a variety of different alternatives. And in many instances, the FCC will rely instead on the recommendations of an agency appointed "blue ribbon" panel of industry leaders from the government and private sectors which it has empaneled expressly to undertake the necessary preliminary analysis of the issues and to report to the Commission with an adequate record from which it can move the matter forward.

Whether the issues start as a petition for rulemaking, develop from the progress of an experimental license, or are the results of the work of an Advisory Committee or the comments on a Notice of Inquiry, before rules are actually adopted the Commission must issue a Notice of Proposed Rulemaking in which a specific allocation scheme or technical regulatory restructuring is proposed. After a record is developed from the public comment on that proposal -- and typically only after months (occasionally years) of further debate and analysis by the Commission and its staff to resolve the often contrary and conflicting views, new regulations and or a new spectrum allocation, will be made. Of course, those regulations will then be subject to administrative -- and usually judicial -- reconsideration for several years thereafter.

A proposal for a new spectrum allocation -- particularly one intended to satisfy the requirements of a new radio service or new technological breakthroughs -- is not likely to be adopted quickly; historically allocation proceedings will run, start to finish, closer to three years than three months. It must be remembered that the creation of the cellular service took more than a decade, from the initial request for an allocation of a cellular block to the initial acceptance of applications for licenses in the largest thirty markets. Obviously, those kinds of dealys can be an unacceptably long time for a technological innovator to wait before it even gets the chance to prove out its idea. To alleviate the impact of this delay, many innovators apply for an experimental license by which they are allowed to build and operate new communications devices and systems in a controlled environment in order to prove out both the technology and the consumer acceptability and usefulness of new products.

Because most experimental licenses can be issued by the FCC's staff, the time factor associated with a grant of such license is much shorter than that needed for obtaining a license to use previously unallocated spectrum. The license will typically grant the licensee the opportunity to develop and even to operate -- on a non-interfering basis -- new technologies and or systems on as large a scale as the licensee can prove is needed to establish the viability of the new equipment or service. The FCC has recently even allowed licensees to market new services or products commercially in a controlled environment, in order to establish the demand elasticity for the proposed services. The decade long market test of the Airfone service, and many of the most recent PCN proposals, have included a "commercial" marketing component. However, as a general rule, the Commission is loathe to allow any wide scale commercial operations of new products or services which might create substantial consumer expectations even before the new product or service has been permanently authorized spectrum allocation or rules revisions necessary to fulfill its intended scope.

Moreover, by the time decisions on a requested allocation have been made, the original innovator has often long run out of resources necessary to maintain its preeminent technological leadership position in the marketplace. In other instances, the time delay in achieving the requisite regulatory action has allowed larger, well funded organizations to join the fray. With their financial strength, they are better able to take advantage of the new rules; as a result, the innovator is denied many of the economic incentives and benefits of the "innovation". The Commission's records are filled with proposals which are adopted long after the initial proponent has either gone out of business or abandoned the initial concept -- how many remember that the current Digital Termination Services in which Motorola,Inc. recently announced the creation of a wireless PBX product (operating on a licensed basis at 18 GHz) are the outgrowth of the X-Ten proposal initially made by Xerox Corporation but abandoned by Xerox before it reached fruition at the agency.

The FCC has recently recognized the stifling effect that its long administrative processes can have on innovation and on the ability of smaller companies to raise the capital necessary to create new developments. It has therefore proposed to give a "pioneer's preference" to innovators, rewarding them with a headstart in the marketplace if their idea is successfully adopted through new rules. But even this proposal has created controversy both as to the definition of what is truly a "pioneering innovation", and as to what the rewards should be to assure that the innovation, in fact, achieves the widest use in the marketplace.

The last decade of advances in wireless technology has occurred in the context of -- and, indeed, in spite of -- these administrative procedures. And the next generation of wireless networks will similarly be subjected to these administrative processes as the Commission continues to allocate a very valuable and limited resource -- the radio spectrum -- among numerous competing demands.

Licensing Issues

Once the FCC has decided to allocate spectrum, either by changing the rules for the use of a particular band or by the creation of a new radio service in a unique radio band, only a part of the process for getting service to the public has been completed. The FCC's history suggests that as much time can be spent in actually issuing the operating licenses for the newly created service.

Over the last decade of wireless system growth, the Commission has tried a number of licensing schemes for wireless communications technologies, from cellular to mobile satellite to private radio SMRs. In each case it has acheived mixed results in speeding service to the public. A brief review of some of the Commission's past approaches is therefor instructive.

A. Cellular Licensing

It has been over eight years since the FCC first accepted applications for cellular licenses for the largest thirty markets, and it is likely to be as much as two more years until the last of the cellular licenses is awarded. During that time the FCC has tried a variety of licensing approaches designed (a) to determine the most appropriate candidate for the license while (b) limiting the applications process to parties truly interested in providing cellular service to the public.

At first, the Commission awarded cellular licenses only after comparative hearings at which the applicants were considered on the basis of which one proposed the best service to the market. In part by reason of the expense of prosecuting such applications -- both in preparation of the comparative case and in the administrative litigation that followed the filing -- the number of applications filed for the largest cities ranged from a high of thirteen to a low of only two (an amazing anomaly in view of the thousands of applicants who filed for the much smaller, less valuable MSA's).

The comparative process had the benefit of limiting the number of applications, and presumably subjected applicants to scrutiny as to the sincerity of their proposals. But it was both time consuming and staff resource draining. Moreover, many of the applicants, recognizing the risk of the litigation, settled the litigation among themselves and apportioned the license ownership voluntarily; therefor, any perceived benefits of the culling process were not being obtained from the hearing in any event. And on review of the various hearing decisions, it became clear that the only valuable distinguishing criteria was the coverage proposed by each applicant -- in one instance the ONLY difference between the applicants was a thirty-two square mile area of coverage, and that difference was the decisional factor. In the broadcast arena, program responsibilities and proposals might have an impact on the public interest standard. But in the common carrier field, where minimal technical qualification differences were not comparatively significant, the FCC realized that comparative analyses would at best yield miniscule differences among applicants which could not justify the burden of the hearing processes.

The Commission then chose to award cellular licenses by lottery, deeming all applicants who could meet minimal qualifying standards to be equally qualified to hold the license, thereby justifying the "choice by chance" approach. However, with the skyrocketing value of cellular licenses having been established in both the public and private marketplaces, these lotteries were viewed by the investment marketplace as excellent "get rich quick" opportunities. In order to assure that existing applicants were not frozen out of the lottery, the Commission removed virtually all vestiges of eligibility hurdles; as a result, such diverse interests as investment partnerships, estates, and family trusts were all applying at dizzying pace.

Moreover, most licenses, once won, were very quickly sold to existing operators either to increase their general portfolio -- and thus their overall value in the public capital market -- or as strategic additions to larger, regional systems. In essence, then, the licensing process was creating a private auction of the awarded franchises, since the potential that the serious operator would win a license was so small that it was easier for many such operators to simply avoid the application process and instead concentrate their energies on the after-license-grant acquisition activities.

The Commission tried several methods to limit the number of purely speculative applications while expediting the time between the filing of applications and the grant of licenses. It moved from imposing stiff pre-application financial requirements to limiting consideration of the financial qualifications only to a post-lottery certification by the lottery winner; from allowing cumulation of lottery chances to encourage partial settlements to eliminating any opportunity to cumulate lottery chances through pre-lottery settlements; from pre-screening applications to eliminate ineligible applicants from the lottery to screening only the winning application; from ranking ten lottery winners (to avoid a redrawing if the winner was dismissed) to choosing only a single winner; from allowing limited cross-ownership and pre-lottery alienation of interests in applicants to prohibiting all such activities. Despite all such approaches, the agency received from 300 to 1,000 per market for each of the over 600 markets which have been franchised under the lottery procedures, with the vast bulk of such applicants coming from investors and investment groups as opposed to existing operators or communications-oriented companies.

Effectively surrendering to the inevitable speculative nature of the cellular applications processes, and deciding to put speed of getting service to the public ahead of precedential policy, the Commission has even "construed" its long-standing policy prohibiting the sale of a bare construction permit -- i.e., a permit as to which the licensed system has not even been constructed -- in order to allow lottery winners to sell their permits immediately after grant. Rather than effectively choosing the "best" cellular licensee, then, the cellular licensing scheme has created -- with great agency expense and resource -- a private auction for the limited number of franchises available.

Mobile Satellite

The Commission took a very different tack in choosing the Mobile Satellite licensee. The agency announced very stringent financial and technical requirements for applicants, and set a "date-certain" deadline by which all applications had to be filed. A very limited number of parties applied under these constraints.

Rather than pursue comparative hearings or lotteries, however, the Commission decided that each of the applicants who was willing to establish its financial ability by the deposit of very hefty investment capital would be given an ownership interest in the licensee, and then ordered the applicants to negotiate in good faith the terms of the consortium that would be so created.

In this way, under the threat of getting no interest in the license, and recognizing that only well financed organizations would be ultimate players, the Commission was able to "force" the creation of a single licensee applicant for a single license, a "required" settlement. While the parties engaged in lengthy and often acrimonious negotiations, the nature of the parties -- being well heeled and generally involved in the satellite or mobile industries -- and their desire not to be excluded ultimately saved substantial time and commission resources in awarding the license. This approach was particular effective in this service, where the capital requirements to construct and operate where high, and the available licenses -- one -- very limited.

Private Radio SMRs

The Commission has chosen two different approaches to the award of the Specialized Mobile Radio licenses, which authorize private entrepreneurs to offer two way dispatch type services to business customers under the restrictions which govern private, as opposed to common, carriage. While SMRs also can offer services interconnected to the public switched network, capacity and eligibility limitations generally make this an expensive service for the subscriber or an unattractive offering for the system operator.

Most SMR channels in the 800 MHz band are awarded on a first- come-first-served basis. The licensee must find an area where the requested channels are not in use, and once awarded, the licensee will receive protection from co-channel use within a designated wide area. Each licensee may only apply for a limited number of channels at one time, and additional channels may be requested only after the initial channels are loaded with a certain number of subscribers. Moreover, if the awarded channels are not utilized within a given period of time, as measured by the number of subscribers per channel, the unused channels will be reclaimed. If a licensee needs more channels to expand its system and none are available in the area, it will go on a waiting list, waiting for the reclamation of underused channels.

For SMR channels in the 900 MHz band the Commission has chosen a lottery approach, with a date-certain filing period for each of fifty designated filing areas. Each winner of the lottery was awarded ten channels (without regard to how many they thought they needed) and all winners were required to meet certain deadlines for (a) constructing its system and (b) loading the system with subscribers.

While the SMR industry has grown under this licensing regime, it has obvious drawbacks. The lottery approach drew many speculators, hoping to win frequencies which they could sell to parties interested in expanding their systems. The waiting list approach, however, tends to create disincentives for growth; if an operator is successful in loading its initial system, there is no assurance that channels will be available to increase capacity to add more subscribers. As a result, an active transactions market for partially loaded or unloaded channels is created, the same private auction which resulted in the cellular context.

Standardsmaking

Finally, it is instructive to consider the Commission's different approaches to standards setting, in the context of assuring equipment interoperability from system to system, area to area. The Commission has tried a variety of approaches to achieving intersystem compatibility and spectrum efficiency, from setting absolute technical specifications for the use of a particular band to leaving to the licensees absolute flexibility over the technical specifications for the use of its licensed channels.

In the SMR arena, the Commission has consistently rejected calls for standardizing on the operating protocol used in SMR systems. Instead, it has left to the manufacturing community and the marketplace to determine whether a standard would be used. In fact, no universal standard has been adopted, and instead the subscriber unit of one manufacturer is not typically usable in the system built by another manufacturer. In this regard, the dominance of one manufacturer has been encouraged, as the lack of interoperability has limited the marketability of systems that do not use compatible -- i.e., the same manufacturer's -- equipment. As a result, operators who are not committed for the long term must consider the value of being tied to one manufacturer or another if its system is to be attractive in the future to other operators who are looking to it as a valuable expansion opportunity.

A very different approach was taken in the initial cellular rules. Concerned that cellular services should develop into a nationwide industry, and in particular that universal roaming ability must be assured for cellular subscribers moving from one market to another, the Commission adopted very strict operating protocols, and required that all customer units had to be capable of operating on ANY cellular system, regardless of the manufacturer of the base station equipment used by any given licensee. As a result, the

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subscriber unit market has developed independent of the system equipment market, and only a few of the system equipment manufacturers are even participants in the subscriber marketplace. As desired, universal roaming capability has been acheived.

However, in recognizing the need to introduce digital technology into the cellular spectrum, the Commission decided on a very different approach. The agency was concerned that digital technology was not sufficiently mature to decide among approaches to increasing spectrum efficiency. It was also desirous in any event of furthering its policy of relying on marketplace rather than regulatory forces to make such decision. The Commission therefor decided to allocate additional spectrum to the cellular service to meet its expansion requirements and to give licensees absolute flexibility to choose the technology, bandwidth, emission characteristics and other technical features to be used in the newly allocated additional spectrum, thereby leaving to the licensees the choice of technical approaches to solving their capacity problems in the most spectral and cost efficient fashions. The only caveat was that consumer units that conformed to the existing operating protocol -- which assures universal compatibility -- would have to be assured the ability to obtain service in some portion of the licensee's allocated channels, even if new technologies were introduced. The Commission recognized that this might require dual mode -- analog/digital -- cellular phones for some transition period. It nevertheless viewed this as a reasonable compromise between those who favor absolute government standardization and those who would rely entirely on the marketplace.

Indeed, with the flexibility granted by the agency, two unique standards -- Code Division Multiple Access and Time Division Multiple Access -- have been developed. TDMA has been endorsed by the cellular industry trade groups as the standard of choice. CDMA is, however, being studied carefully by a number of large system operators, who view its immediate availability as a better short term solution to overwhelming capacity problems than the long term benefits of the as-yet untested TDMA. Whether this dichotomy will result in two standards, or a de facto CDMA standard overwhelming the industry endorsed TDMA approach remains to be seen, as the cellular industry wrestles with the decision as to which approach will most quickly resolve ongoing capacity problems.

Personal Communications Services -- The Next Regulatory Challenge

It is virtually impossible to get through a week without reading the acronyms CT-2, CT-3, PCN, DECT, GSM, CAI, FDMA, TDMA, CDMA. These are the buzzwords for the concept of a ubiquitous Personal Communications System, in which individuals will be capable of calling, and being called, on a phone identified to them, rather than on a phone identified with a particular station. The term "Personal Communications Services" covers a wide variety of potential offerings. Because cellular service is capable of providing "portable" service, these new ideas have been distinguished from the macro-cell technology of conventional cellular systems by their anticipated use of a "microcellular" design approach.

Suffice it to say that major policy issues need to be addressed by the FCC before PCN services can become realities. The Commission is currently considering the broad variety of issues raised by the potential growth of personal communications in a Notice of Inquiry in Docket 90-314. Obviously, there is a need to test and prove the effectiveness of the technologies being discussed to digitize the mobile spectrum in a way which would allow microcellular technology to operate effectively in a consumer-oriented telecommunications service. Indeed, the FCC has recently issued a myriad of developmental licenses, with more applications pending, to a variety of applicant proposals to design and test in numerous markets the viability of different types of PCN and CT-2 and CT-3 services and facilities, using various technologies. These developmental proposals will, if effectuated, establish not only whether various technologies can work effectively in urban, suburban and rural environments, but also whether such technologies will allow for the sharing of spectrum with different types of existing users, and also, to a lesser extent, whether there is a substantial consumer interest in particular levels of service.

Even assuming the availability and capability to effectively implement the technologies being considered for microcellular technology, the Commission will have to consider many substantive issues before it can conclude either that a separate frequency allocation is appropriate for PCN and PCN-related services or that some relaxation of technical rules governing various spectrum is necessary to allow PCN services on a shared basis. Among the many issues to be considered will be whether there is a need for a separate PCN allocation, or whether existing services can be encouraged to provide these personal services by the relaxation of existing rules. The Commission will have to decide how it should license any systems that it decides to authorize. And it will be faced with the choice of mandating a particular technology for such services to assure network compatibility or leaving such choice to the marketplace, with the potential that each service provider would market proprietary customer equipment which would not be compatible in other markets.

These issues are all presented for consideration in the Notice of Inquiry in Docket 90-314. Initial comments in this proceeding were received in early October, with more than 100 parties filing substantive comments. Not surprisingly, virtually every segment of the communications industry weighed in with an opinion on one or more of these issues. Existing users of the spectrum and existing service providers questioned the wisdom, need and efficiency of a separate allocation of valuable spectrum for a still untried, and questionably valuable service, while the more entrepreneurial groups urged expedited consideration of a separate allocation of anywhere from 140 to 200 MHz for a new PCN radio service, principally in the 1.8-2.1 GHz band. Nor was there unanimity on the technical standards which would govern the use of any allocated spectrum, with proponents of Time Division Multiple Access and Code Division Multiple Access split as to which of these technologies will provide the highest quality, lowest cost, spectrally efficient and greatest capacity for such services.

That there is interest in the development of advanced Personal Communications services and systems cannot be gainsaid, based solely on the size of the response to the Notice Of Inquiry in Docket 90-314. On the other hand, the ability to achieve a consensus from such diverse interests, absent a substantial technological breakthrough which would avoid the need for new regulations or allocations -- for example by the development of systems and products capable of operating on a large scale basis under the Commission's Part 15 rules -- appears achievable only after a long, arduous, and likely rancorous rulemaking proceeding, which is certain to include highly complex social, economic and political issues and require the delicate balancing of significant interests. Such a regulatory structure does not appear likely to provide a short term framework for the commercial development and introduction of new technologies.

A Recommended Approach

So long as spectrum allocations are to be governed by administrative procedures, and scarce resources are to be allocated only after the opportunity for public comment and debate -- fundamental precepts of our democracy -- the ability of the government to introduce technological advances into our communications capabilities will necessarily be limited, and will require slow, often painstaking processes. On the other hand, the inability to act unilaterally and without due process does not need to translate into an inability to act decisively once that the evidence establishes that there is a public need for a new service and/or technology which cannot be fulfilled within existing allocations or regulations.

The Commission has a variety of precedent to look to in choosing the best approach for bringing Personal Communications Services to the American public. It also has the benefit of being able to encourage such development on the foundation of an extremely advanced wired and wireless telecommunications network. In other countries who are currently expediting the licensing of PCN-type services -- with varying degrees of real success -- the telecommunications infrastructure is not advanced, and thus allocations need to be made even before technologies have proven out and demand for particular services has been developed. The FCC, however, can afford to wait for the completion of the many developmental projects which are already underway before making any leaps of faith on the outcome of such developments. By waiting until concrete evidence exists of the demand for such services, the ability to meet the demand with the available technology, AND the inability to meet the demand within existing frequency allocations and regulations, the Commission can better assure that regulatory approaches and solutions do not run past the state of technology. By putting the creation of a new service before the demand and technology to meet it have been proven, the Commission runs the risk of creating enormous negative impacts on existing service providers and spectrum users without any offsetting public benefit from such decisions. One need only look at the Commission's disasterously premature handling of the DBS Service which was created over a decade ago on the promise of immediately foreseeable services, at great expense to existing licensees of the 12 GHz band who had to move to other frequencies, and in which today there are still no concrete plans for a satellite launch which will use those frequencies for a high powered DBS service, to see the distasterous consequences of such precipitous actions.

If a new radio service is to be created for the PCS group of services, then in choosing a regulatory approach, the Commission should recognize that, precedentially, it has been most successful when it has allowed the marketplace, rather than its applications processing procedures, to govern the timing and location when such services are introduced into a given market. For example, using the approach utilized in the initial licensing of the 800 MHz band for SMRs, the Commission should rely on interference criteria, rather than market designations, to determine how many and when microcell systems will be able to operate in a given metropolitan area, and leave to the marketplace, rather than to specific regulatory standardization, the determination of operating protocols. Such an approach is more likely to avoid long delays in the licensing process than to create them. By restricting eligibility to those parties who are financially able to construct the proposed system, minimizing those instances when comparative analysis is necessary to avoid mutual exclusivity, and imposing strict performance standards on parties who are granted a license to assure that they construct and operate the systems they propose -- or face license forfeiture not unlike the revocations which occur in the SMR industry -- the Commission is most likely to assure the quick implementation of a new radio service without incurring the undue time delays and resource expenses which have characterized its cellular licensing programs.

In conclusion, it cannot be denied that technology is capable of driving the movement to a wireless society, allowing the consumer to access the underlying telecommunications network on a personalized basis without the limitation of a wire or cable. If the limits of technological innovation are to be achieved in this country, the federal regulatory regime -- from Congress through the executive branch and into the Federal Communications Commission -- will play a key role in determining not only what technologies are favored, but also what markets are served, and how.

Technologies that can share spectrum with existing users or substantially increase the capacity of existing services should certainly be favored over less efficient proposals. The FCC will likely be forced to deny spectrum to certain uses in order to provide the most economically and politically favored users adequate spectrum for meeting anticipated demands. While European models could hold some influence over the decisionmaking, the domestic needs of consumers and industry must ultimately be the model used to determine allocations. Most importantly, the Commission should not allow the exuberance of technological advances designed to cure clearly ineffective communications networks in other countries to drive it to hasty decisions which could negatively impact the highly advanced wired and wireless infrastructure already in place domestically.

The technologists role will be to continue developing greater spectral efficiencies into devices at lower costs, so that manufacturers and users are incented to utilize such devices and systems. The regulators role will be to accommodate those systems and services that achieve the greatest spectral densities for the most valued uses. The likely confluence of private and common carriage, of personal and business communications, and of wired and wireless networks into a seamless ubiquitous system, will challenge the limits of both the technologists and regulators creativity in satisfying the public's demand for advanced communications capabilities.

Telecommunication Regulatory Policy Developments in the ASEAN Countries

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ABSTRACT

The ASEAN countries (Association of South East Asian Nations) represent a microcosm of countries in various stages of development which provide the opportunity to examine a diverse set of telecommunications regulatory policies. The telecommunications sector is different in each of the ASEAN countries and each must necessarily respond to its own social, political and economic needs. The changes in telecommunication regulatory policies and trends toward different forms of de-regulation, liberalization of markets and privatization of the telecommunication authorities of the ASEAN are explored.

1. INTRODUCTION

It is almost passe now to point to the worldwide trend in telecommunications toward deregulation and privatization. The United States, Great Britain and Japan have set the stage and provided examples for moves in other countries. In responding to ever stronger market forces and the need to move more forthright in terms of capital intensive infrastructure development, government telecommunications authorities are under pressure to allow a freer access to telecommunications markets. The provision of services by competitive enterprise and the concerted look toward the de-regulation and perhaps even privatization of government telecommunication organizations is now a part of the development agenda in many countries.

While the privatization of British Telecoms and NTT in England and Japan respectively and the break-up of AT&T in the United States provide examples of the worldwide trend, they are by no means necessarily models for de-regulation and privatization in other countries. In essence, the need for de-regulation arose from the declining benefits of economies of scale and scope within the natural monopoly framework. In value-added services, the concept of natural monopoly could no longer be established or justified. The general trend, however, seems cyclical as nearly six years after de-regulation, the long-distance market is so shaped that re-regulation is being called for in the United States.

Indeed each country must respond to its own needs and priorities within the social and political context in determining the form and extent to which de-regulation and privatization may be useful. The ASEAN nations may provide a microcosm example of the varied forms the trends in de-regulation and privatization are taking in many other countries. They point to the need to reflect not only on regional transformations but on the individual country differences as well.

The six ASEAN countries (Brunei Darussalem, Indonesia, Malaysia, the Philippines, Singapore and Thailand) represent an area of the world with one of the highest economic growth potentials. The region has a higher per capita GNP and volume of exports than Eastern Europe. Cooperation in telecommunications in the region has resulted in the establishment of undersea cable systems linking each country and with the Transpac cable system across the Pacific to Hawaii and on to North America. An undersea fibre cable linking Singapore with Marseilles, France to be completed in 1994, will result in a complete fibre optic connection from Europe to Japan via Southeast Asia. In addition, Thailand, Singapore, Malaysia and the Philippines and more recently Papau New Guinea (a non-ASEAN country) will be using the Indonesian Palapa satellite system. As cooperation grows in economic arenas, ASEAN could become a major force in political and economic matters similar in nature to the European community.

Nonetheless each ASEAN country is on a different growth pattern and has its own established priorities for economic development. From the more developed Singapore and the near NIE's (Newly Industrialized Economies) of Malaysia and Thailand to the lesser developed Indonesia and Philippines, the ASEAN countries have pursued rather independent courses for their telecommunications sector despite the regional cooperative efforts. The response to telecommunications growth and development is quite different in each country and must therefore be analyzed on a country-by-country basis.

More recently however, world economic changes and pressures have necessitated that the ASEAN region act in concert in such forums as the Uruguay Round of trade policy talks of the GATT (General Agreement on Tariffs and Trade). The position of ASEAN is shifting vis-a-vis other lesser developed countries in terms of the highly protected services including telecommunications.[1] While liberalization in trade services is being supported by ASEAN as a whole, the reasons are different in each country and there is a fair amount of divergence in the views. It would therefore be premature to refer to ASEAN as a trade block. An understanding of the characteristics of each country is required and is the focus of the analysis here in terms of trends in telecommunication regulation. Four of the six ASEAN countries, namely Indonesia, Malaysia, Singapore and Thailand will be discussed as examples of different schemes for development of the telecommunications sector and the need to understand the conditions under which various forms of policy exists and the changes which are occurring.

There is one important common element in each of these countries in terms of providing basic telephone service. For the low and middle income countries, problems of providing services to remote and rural areas still require subsidization by a government monopoly. For distributive reasons, competition in basic services cannot yet be justified. Much of the information in this article has been drawn from a research project at the East-West Center in Honolulu, Hawaii investigating the infrastructure and investment impact of telecommunications on the ASEAN economies.[2] We are indebted to our many friends in each country who graciously answered our questions in open interviews.

2. INDONESIA

Indonesian telecommunications is, and will remain in the foreseeable future, a government owned and controlled sector. Nevertheless, while privatization of the telecommunications authorities in Indonesia is anathema to meeting development goals set forth in priorities by the government, trends in the liberalization of markets and services are making their mark. Perumtel and PT Indosat are charged with primarily domestic and international telecommunications respectively and remain state monopoly enterprises. However, the needs to provide better services and to expand infrastructure in the face of high capitalization and operating costs has prompted Indonesia to relax regulations somewhat to allow for greater private participation.

Perhaps the most significant recent development in Indonesian telecommunications regulation change is the adoption and implementation of Law 3/89, known as the Law on Telecommunications, dated April 1, 1989. One of the more significant aspects of this law, which is just beginning to be fully utilized, is the opening of non-basic telecommunications services to other than the government telecommunications organizations. Specifically Chapter IV, Article 12, Paragraph 2 of Law 3/89 reads:

> "A body other than the organizing body [government authorities] ... may organize basic telecommunication services on the basis of a cooperation with the organizing body, while non-basic telecommunication services may be organized by another body without a cooperation with the organizing body."

The law further states in the same Chapter, Article 19, Paragraph 3 that:

> "The organizing body and other bodies referred to in Article 12, paragraphs (1) and (2) in providing and promoting telecommunication services, shall be authorized to import, control and own telecommunication equipment for the provision of telecommunication services" [3].

In effect, this law will allow for ownership and control of telecommunication equipment for non-basic services provision by private organizations. In addition, more private participation will be allowed in providing basic telecommunication services in cooperative arrangements between private organizations and the governmental telecommunication bodies, namely, Perumtel and PT Indosat.

While not changing the structure of government ownership and control of basic telecommunications in Indonesia, the law will allow for improved access to Indonesia's telecommunications markets and will, it is hoped, help improve the capitalization problems of developing telecommunication infrastructure as well as operating and maintaining services. Private organizations from outside Indonesia will still have to do business through joint-venture arrangements with an Indonesian organization. While it is doubtful that further privatization will occur in Indonesia and that the government entities will maintain control, Indonesia has, in its own way, begun to address the problems common to many developing countries in terms of realization of capital and services for the ever growing demand in their country.

In an attempt to close telecommunications services provision gaps, two strategies, namely, increasing accessibility in rural areas and increasing phone density in high demand areas have been prioritized. In addition to World Bank loans and "soft" loan financing with cooperating foreign governments and financial institutions, funds from the private sector have been sought in terms of private participation as allowed for under Law 3/89. [4]

Indonesia's prowess in satellite telecommunications through its Palapa satellite system continues to grow. With the recent re-launch of the Palapa B2R satellite that was recovered in 1984 by the U.S. Space Shuttle from an incorrect orbit, the Palapa system will again be operating with a full compliment of satellites on orbit. Tenders are now pending for a new "C" series Palapa satellite to meet the growing current and future needs. Four other nations in the region, the Philippines, Thailand, Malaysia and Singapore use the Palapa system for internal communications, mainly television broadcasting. Papau New Guinea is the newest signatory to the Palapa system and becomes the fifth country in the region to use Palapa.

In many respects, Palapa is becoming a regional system. Although inter-country exchange through Palapa is still limited, Palapa has the potential for data, voice and video exchange between Southeast Asian nations as well as providing alternative routing for the ASEAN undersea cable systems. In addition, Palapa could conceivably provide access for private as well as public networks. However, the political will to cooperate and the structural, economic and financial advantage to cooperating parties would require comprehensive negotiation. Strategies to overcome regulatory differences would also need to be addressed.

It seems clear that there is an economic necessity to keep Palapa under government control. Reaching a large number of islands with basic services may only be feasible through the distance insensitive cost benefits for thin-route communications provided by the Palapa satellites. This advantage could also be utilized by the Philippines and Malaysia as well. Interestingly, the future status of Palapa as a regional system may be in some question with Asiasat now in orbit. Whether the government controlled Palapa system will or should be geared to compete with Asiasat in the region remains unclear.

3. MALAYSIA

The telecommunications authority in Malaysia, STM (Syarikat Telekom Malaysia Berhad) is in the process of privatization. Previously, the organization JTM (Jabatan Telekom Malaysia) was the government owned and controlled telecommunications authority under the Ministry of Energy, Telecommunications and Posts. STM, is now a semi-autonomous organization which is to offer public shares by the end of 1990. In reality however, the government of Malaysia controls and will continue to control a majority share in STM. The government interest will insure that control of STM is not entirely the private affair of STM. In such a state of semi-privatization, STM has been able to begin a re-organization process to make the company more efficient. Yet, it is still under the policy control of the government which, lacking an overall strategy for services provision, continues to saddle STM with problems of unclear guidelines for service development.

The direction of privatization of telecommunications in Malaysia is step-wise with de-regulation perhaps to follow the financial stabilization of a privately financed STM. With ever increasing demand for more and higher quality services, government licensing for private provision of non-basic services such as radio paging will continue. The question of a license being granted for a second operator to provide basic services in competition with STM is also not out of the realm of possibilities in Malaysia. However, the problem of assuring continued growth in rural telecommunication services with competitive basic service providers is still in doubt. Short of a government requirement to provide rural services, which are likely to result in a loss of profitability, a competing basic service provider would most likely only concentrate infrastructure development and service provision in the more lucrative urban areas. This would leave STM in a poor situation of having to provide costly rural service with a probable decline in revenues from urban areas used to cross-subsidize rural service. Faced with this dilemma, the impetus to continue a monopoly for STM in basic service provision is likely. Currently there are approximately 28,000 staff and employees of STM. While this number will remain fairly constant, new skills are needed in the areas of computers and software, marketing and finance. The costs of retraining are high. In terms of sales, normal marketing activities of a completely private firm are somewhat stymied since it is difficult to lower the previously high sales salaries in exchange for commissioned sales. Changing attitudes is a slow process both for employees of STM in a new, more competitive environment as well as for the government to learn the advantages of keeping hands-off of the business activity of STM.

In the next five year period, 1990-1995, STM plans to invest approximately 1 billion ringgit (US$370 million) per year for network and services expansion. Approximately 20% will be for switching, 20-25% for local networks and cabling, 20% for transmission equipment, 10% for international direct dial services and 5% for computerization of operations. The remainder will be primarily in building and land acquisitions. This investment does not include the operating expenses of STM.

STM has no intentions of getting funds from the government for investment purposes. Supplier credits and competitive financing packages will be important determinants for selection of vendors. While STM has approximately 1/2 billion ringgit (US$185 million) in back reserves, its debt equity is about 1.6 billion ringgit (US$593 million). That will need to be brought down to about 1 billion ringgit before floating of public shares on the Kuala Lumpur Stock Exchange. The offer of public shares, due for the end of 1990, will be the major source of corporate financing for STM.

STM has done rather well in terms of keeping up with demand for telephone service. With approximately 11.5% demand growth for phones per year, wait lists have been trimmed over the last several years although some 68,000 potential customers still remain waitlisted. Improvement of services, including new installations, along with the restoration and upgrading of existing systems are important. With approximately 1 million home customers and 4 thousand business customers, STM, in Kuala Lumpur especially, will look for local service improvements which are needed in terms of quality upgrades in the network.

Perhaps the most difficult questions in terms of the privatization process for STM still remain. Government decisions on service provision mandates and allowance of private sector competition in services is unclear. For instance, STM has spent considerable funds in research and development of the "ATUR 800" mobile services which the government recently decided will be licensed to a competing entity. Without a strategic policy, it will be difficult for STM to operate effectively as a private competitor. In addition, more competitive tariffing policies will need to be considered in order to make use of STM services over other leased services.[5] While STM is promoting its data services (MAYCIS and MAYPAC) to businesses, it may be too late to include in terms of options to users who see private leased lines as a cheaper route.

Nonetheless, the moves toward privatization of telecommunications in Malaysia are expansive and far-sighted. It is important to note that private telecommunication organizations are playing a leading role in the privatization efforts in Malaysia. The participation of Cable and Wireless of Hong Kong in the moves toward privatization and for other multinationals such as Alcatel in gaining access to the large customer premises equipment (CPE) market cannot be ignored. Market stimulation for services through more competitive tariffing and increased private financing will help create stronger and higher quality network infrastructure and services in Malaysia.

In addition, there appears to be a growing demand in Malaysia for data transmission both within the government and for private industry. A difficulty remains in terms of addressing the market size and level of computerization. The Malaysian Administrative Modernization and Management Planning Unit, MAMPU, of the Prime Minister's Department has been charged with studying government computerization and telecommunications network needs. A Malaysia Federal Telecommunications Review study was begun in 1989, however, the results are as yet unavailable. In the private sector, the Association of Computer Industry Malaysia, PIKOM, has undertaken a survey of the Malaysian computer industry to assess the market size and level of computerization among the different industries. Preliminary results should be available soon. These efforts should help policymakers in determining the direction of data telecommunications regulation in Malaysia in the future.

4. SINGAPORE

Singapore Telecoms, the government owned and controlled monopoly telecommunications authority (Statutory Board) has been highly successful. With a telephone density of 47 sets per 100 population and nearly one million access lines for a population of 2.6 million people, Singapore has one of the most modern phone systems in the world. Singapore Telecoms has revenues of approximately S$800 million (US$421 million) per year and is planning to invest S$2 billion (US$ 1.053 billion) over the 1990-1995 period. Singapore Telecoms is expanding beyond the borders of Singapore with more and more foreign investment and is beginning to provide services and expertise to other telecommunications authorities in other countries. Currently, Singapore Telecoms has joint venture investments in Thailand, Sri Lanka, Mauritius and Saudia Arabia. In addition, Singapore Telecoms is looking to establish itself as a multi-national corporation in Brunei and Indonesia with an eye on China as well. Its strategy is to provide international marketing, form alliances to provide services and provide consultancy services for planning, operations and maintenance.

Perhaps the most significant trend in Singapore has been the ability of a government owned and controlled entity to keep abreast of technological developments and provide complete telecommunications services. Where economies of scope for the public sector telecommunications authorities are being constantly reduced by innovative technology developed in the private sector, Singapore Telecoms has been in the position to simply purchase that new technology outright and incorporate it into its systems. The erosion of economies of scale which may compel a shift to more liberalized policies in other countries is simply not taking place in Singapore. Due to its relatively small size and single urban nature, Singapore Telecoms has been able to develop a comprehensive telecommunications system without the burdens of a rural sector or multiple urban areas as in other countries. In addition, Singapore Telecoms works closely with the National Computer Board of Singapore, NCB, whose purpose is to develop information technology, in the development of sophisticated digital data networks and services. Along with France, Singapore is the only other country in the world today that has installed fully equipped digital switches ready to provide ISDN services in the public switched network.

Singapore Telecoms, despite being a government monopoly, has been able to keep abreast of the demand for information technology services. They are the monopoly provider for data transmission lines for the flourishing financial businesses of Singapore and also provide the connections for such networks as the Singapore Mercantile Exchange linked with the Chicago Mercantile Exchange and TradeNet, an international trade document exchange network created in a collaboration of government agencies and trade associations and now operated by Singapore Network Services Pte. Ltd. These examples show that the argument for the liberalization of markets for competition of services is limited in context in each country.

Nonetheless, other factors are beginning to shape a structural shift in Singapore. With reciprocity in telecommunications trade at issue in the Uruguay Round of the GATT talks, Singapore is concerned that holding its position vis-a-vis other countries will be more difficult if it does not begin to open its own markets and services. With Singapore's expanding interests into markets of other countries, it will be under increasing pressure to liberalize markets at home. In addition, the need to change the cumbersome nature of internal procedures as a Statutory Board is cited as a reason to move toward a more efficient private organization.

This liberalization process will be slow and well planned in Singapore. It is not likely that services, even non-basic services such as paging, will be opened to competition in the next several years. However, the first steps toward opening Singapore Telecoms to outsiders will be in the form of nominal privatization. Currently, Singapore Telecoms has under study plans to implement a privatization program. Nine companies were invited to submit proposals for the privatization scheme. It is expected that one or more of these companies will then act as an advisor for the privatization program. Singapore Telecoms has a possible market capitalization of S$10 billion (US$5.26 billion). It is expected that flotation of Telecoms stock on the Singapore Stock Exchange (SES) could come in 1992 or 1993.

Singapore Telecoms will be the first Statutory Board to be privatized in Singapore. Nonetheless, it is expected that initially, the government will continue to hold a 90% share.

5. THAILAND

Rapid economic growth in Thailand has brought on a very high demand for telecommunications services in the past several years. Phone demands have increased and TOT, the Telephone Organization of Thailand, is extremely hard pressed to provide adequate basic services. The current plan (Fifth Development Plan) which runs through 1992 calls for the installation of 1.2 million phone lines in Thailand. To date, approximately 750,000 of those planned lines have been installed. In addition, TOT's urgent Sixth plan called for the installation of another 200,000 phone lines for the Eastern Seaboard industrial plants. The first 100,000 of these is being installed under two separate contracts to Ericsson and NEC. When the plans are complete, TOT estimates that there will be approximately 2 million phone lines in operation with the need for at least 1 million more to cover the existing waitlist and anticipated further demand. A target of 3 million lines is being set for the Seventh Development Plan (1992-1996) although some estimates have put that demand as high as 6 million new lines. However, under current budget and debt limits set, only about 200,000 additional lines per year could be financed by foreign loans guaranteed by the government and the TOT budget.

Providing basic telephony service in Thailand is still critical. The high capitalization costs to install the needed phone lines, upgrade current systems and to operate and maintain at a higher level than is now undertaken has put growing pressure on the Thai government to begin to make changes in the structure of TOT. While Thailand would seem to be a likely candidate for the privatization of its telecommunications entities, that is unlikely due to the internal political conditions of the country.

Under one scheme, of which the United States is a strong proponent, TOT would be privatized. The U.S., through the NTIA (National Telecommunications and Information Administration), in February 1990, called for the rapid privatization of TOT and a merger with CAT, the Communications Authority of Thailand, responsible largely for international telecommunications. The privatization plan, however, is looked at with considerable doubt by Thai officials as the assumptions under which a privatization scheme would work in Thailand are, according to them, not correct. The need for the Thai Parliament to amend the statutes of TOT and CAT is highly unlikely in the vulnerable period the government now finds itself in. In addition, the very strong trade unions of TOT and CAT have consistently opposed any privatization scheme. In any case, it would take at least another two years for a first offering of TOT stock which would not help the more immediate needs.

The Thai government does not see such an urgent priority be given to the telecommunications sector and is unwilling to make rapid changes in TOT structure. In order to be able to meet its targeted plans, TOT has proposed a Build, Operate and Transfer (BOT) scheme similar to that in Indonesia several years ago before the change in the latter country's telecommunication law. Given the extended period needed in Thailand to make structural changes, the BOT scheme is seen as a means by which to finance the infrastructure development proposed. Under such a scheme, no laws would need to be amended and TOT will remain the monopoly operator of telephone services. While this solution may not satisfy those who wish to see a more rapid improvement in telecommunications in Thailand, it is a solution which is politically acceptable and for now will have to suffice. Of the 3 million lines proposed to be built in the Seventh Plan, TOT is proposing that 2 million be installed in Bangkok and 1 million in rural areas. Firms interested in the BOT scheme are required to put up 1,000 million baht (US$40 million) in a bank guarantee and will also be required to build switching systems in Thailand for the project.

Apart from basic telephone service, the worldwide trend in liberalization of telecommunications services can be observed in Thailand today. Due largely to the financial constraints of the State budget, the Ministry of Transportation and Communications is giving approvals for private concession development of some telecommunications services. Included are such projects as a domestic satellite-based data transmission network for banks, institutions and manufacturers who need reliable data services. Recent equipment purchases from Northern Telecom and Alcatel and the rapidly growing customer premises equipment (CPE) market point toward how the liberalization of telecommunication markets apart from the public switched network may prove fruitful and could eventually help speed overall improvements in domestic services.

In addition, the recent launch of ASIASAT may provide the basis for expanded telecommunication services in Thailand. One of the high powered C-band spot beams of the satellite is focused on Thailand and has the

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potential to provide cost efficient television transmission as well as rural telephony and data exchange services. As yet, a clear policy for the use of ASIASAT has not been established and it remains unclear to what extent private enterprise will be allowed to erect and operate satellite transmission and/or receiving equipment for private telecommunications networks or to add to the infrastructure of the public network.

6. CONCLUSION

While the general trend worldwide is for de-regulation, liberalization of markets and moves toward privatization on the part of the telecommunications authorities in many countries, each country must be looked at separately to understand the economic, political and social factors surrounding the development and implementation of such policy changes. For example, while British Telecoms has been privatized in Great Britain, the telecommunications authorities of France and West Germany remain powerful government entities. De-regulation in France is in the form of a management overhaul of France Telecoms and in Germany a mere opening of telecommunications equipment and service markets to outside bidders is evident. In both France and Germany, the monopoly over telecommunication networks and services will remain.

In the ASEAN region, countries are characterized by their different governments, social and cultural milieus, and economic policies and strategies. The priorities in development are different and so it is no surprise that the development of the telecommunications sector is quite different in each country. However, it is also acknowledged that the growth in the economies, and perhaps the success of the ASEAN region as a whole, requires a concomitant growth in the telecommunications sector. The impressive economic results of a country like Thailand for example are matched by the very sharp and frustrating increase in the demand for telecommunications services which are lagging.

Whether telecommunications in any country can become a leading sector for development as seen in Singapore or suffer the evident neglect which can be seen in some of the systems operations in Thailand is largely a policy question. With the high capitalization costs of telecommunications systems and the pressure to build higher capacity and better quality infrastructure, governments are reconsidering the policies of the state owned and controlled monopoly operating entities. The need to liberalize telecommunications markets, especially in terms of non-basic services, and to look at the privatization of the telecommunication authorities and/or the private participation in the government controlled enterprise is confronting each nation.[7]

In addition, it will become increasingly more important for ASEAN to establish strong regional linkages in order to continue to attract capital flows for infrastructure development from Europe. With an inevitable focus of Europe 1992 on the opening of Eastern European markets, countries of the ASEAN cannot afford to lose one the three major sources of private financing (Japan and the United States are the others) for its telecommunications sectors. In order to do this, a focus on regional policy and coordination of the trends in policy change may provide a better platform from which to remain an attractive investment opportunity to Europe.

Faced with high costs and the need to provide better service, financing from outside the government for telecommunications is required. This is perhaps the single most important factor driving the trend toward liberalization of telecommunications in the lesser developed countries of ASEAN. In the more developed Singapore, the need to respond to international pressures as it moves well beyond domestic basic service provision into the world market for telecommunications services, requires it to substantially re-evaluate its position vis-a-vis privatization and monopoly control of services.

It will be important for the World Bank and Asian Development Bank to continue and increase support for the development of telecommunications in the region. Loans and grants however are not enough and private participation in the form of capitalization through privatization of the telecommunication authority and/or of private participation through various politically acceptable schemes in network development projects are inevitable. The form that these changes take place are different in each country but unavoidable.

The problems faced by many countries in telecommunications are not unique. The policy solutions for each country may be somewhat different yet the need to fully comprehend the options available and to look to examples beyond those provided by the developed countries is very much needed. It may be possible for the ASEAN region as a whole to further develop cooperative efforts in terms of understanding telecommunications policy development. In turn, this could provide a substantially more appropriate example of the implementation of different forms of de-regulation, liberalization of markets and privatization schemes for other countries of the world. Perhaps the ITU (International Telecommunications Union) and other regionally based organizations could promote more exchange and cooperation on these critical policy issues. Already the Center for Telecommunications Development (CTD) of the ITU and regional organizations such as the Asia-Pacific Telecommunity (APT) provide technical telecommunications training and skills formation programs. The annual ITU Telecoms Asia conference held in Singapore brings together vendors and users to promote new technologies and their development in the region. Perhaps similar efforts could be made in terms of the development of cooperative efforts in education about and the formation of regulatory policies.

REFERENCES

[1] Ariff, Mohamed, & Tan, Loong-Hoe (Eds.), ASEAN Trade Policy Options: The Uruguay Round. Institute of Southeast Asian Studies, Singapore, 1988.

[2] Hukill, Mark A. and Meheroo Jussawalla, Telecommunications Policies and Markets in the ASEAN Countries. Columbia Journal of World Business, Vol. 24, No. 1, 1989.

[3] Kramadibrata, Soedjono, 1. Dynamics of Indonesian Telecommunications and 2. Strategic Plan of Indonesian Telecommunications. Ministry of Tourism, Posts and Telecommunications, Jakarta, Indonesia, April 1, 1989.

[4] Roestam, Sumitro, Closing the Gaps of Telecommunication Hardware and Software Developments in Developing Countries: The Indonesian Experience. Paper presented by Safwan Natanagara at the 6th World Communications Forum, Japan Society of Information and Communication Research, Tokyo, and the Asian Mass Communication Research and Information Centre (AMIC), Singapore, March 1990.

[5] Daud bin Isahak, Meeting Challenges of Privatization in Malaysia. In Bjorn Wellenius, et.al., (Eds.), Restructuring and Managing the Telecommunications Sector. Washington: The World Bank, 1989.

[6] Cheah Chee-Wah, Information Policy and Telecommunication Services Trade in the ASEAN Region. Paper presented at the 8th Conference of the International Telecommunications Society, ITS, Venice, Italy, March 1990.

[7] Jussawalla, Meheroo, et. al. (Eds.), The Cost of Thinking: Information Economies of Ten Pacific Countries. Norwood, NJ: Ablex, 1988.

A Roadmap to Privatization:
The New Zealand Experience

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1. Abstract

Due to the rapidly changing worldwide economic realities, over the next five years many governments will be faced with the challenge of privatizing their state-owned telecommunication entities (SOTE). While each country's situation will emphasize different economic objectives and be shaped by its own unique political process, common goals and obstacles will exist. This paper will serve as a useful roadmap for governments facing telecommunication privatization decisions as well as companies interested in being involved in the buy-side of the transaction. Discussed in some detail is the New Zealand Experience, an example of a SOTE privatization that appears to be successful for both state and buyer.

2. Introduction

The term "privatization" encompasses a host of methods whereby a state-owned telecommunications company is removed from total state control. There are seven methods categorized by The World Bank for privatization, ranging from a public offering of shares to a lease or management contract. Each method releases a varying degree of state control.

The movement from state-owned monopolies to private companies evolves through multiple stages, although the privatization process may encompass all stages simultaneously. The stages can be broken into three major categories: Separation; Corporatization; and Deregulation.

The first step towards privatization is the separation of Telecommunications from Posts, whereby telecommunications is recognized as an entity separate from other methods of communications. The natural next steps are to create separate accounting and administrative functions for the entity. Finally, the work force is separated from the civil servant pool resulting in an entity staffed entirely by private citizens.

The next stage is to incorporate and introduce the concept of shares to the entity. These may at first be owned entirely by the state, but eventually will be offered to the general public, or be sold privately to one or several investors. The state may offer a minority or a majority share, but may still retain significant regulatory power.

The final stage is to eventually remove telecommunications from the public policy arena. At this final stage, the entity is operated privately with no more regulatory restraints than other companies operating privately within the state's borders.

3.0 Telecommunications Privatization

3.1 Past, Present and Future

The first major privatization began in 1984 with the sale of British Telecom by the United Kingdom Government. 51% of the shares were sold through an international offering through the public markets, at an equity value of $4.68 billion. Since that time, another six governments have privatized telecommunications to some extent and several more are in the process.

At present, it is estimated that roughly 25 countries are in the process of privatizing, or are considering the possibility of privatizing or liberalizing their telecommunications systems. Another 25 are judged to be likely candidates for privatization or liberalization in a one to two year time frame.

The bulk of potential privatization will be in the more developed countries: Western Europe - with $62 billion worth of potential privatization, followed by South East Asia and Pacific - with $31 billion worth of potential privatization. Although the largest number of privatizations are assumed to be in Eastern Europe, those likely to privatize are estimated to be worth only $5 billion (see Figure 1).

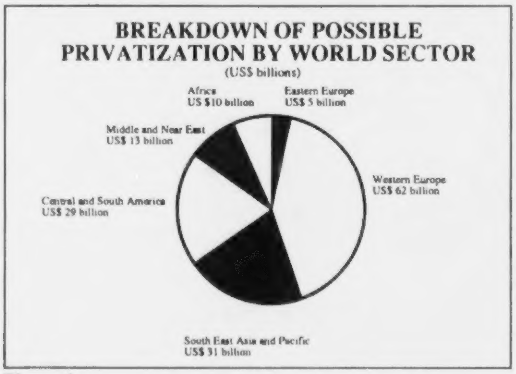

Figure 1

To date, there is not a standardized technique for valuing telecommunications privatization. The price paid per access line has been rising steadily since the United Kingdom privatization of 1984 (approximately US$ 443 per line). Over US$ 1,500 per line is currently being requested for several SOTEs on the block. Over time, buyer enthusiasm for acquiring privatizing SOTEs may dampen if this trend continues.

3.2 Popularity of Privatization

Currently, telecommunications privatization retains high appeal and has become increasingly popular. There are significant benefits to both the buyer and seller of a SOTE.

3.2.1 The Sellers Perspective

The Sellers of a telecommunications entity are actually two bodies: The state and the SOTE itself. Each has different, albeit symbiotic, objectives.

From the state's perspective, privatization accomplishes three critical objectives: reduced national debt, improved service delivery, and the introduction of enhanced services. From the SOTE's perspective, privatization allows easier acquisition of capital, gives access to advanced technology, and removes telecommunications issues from the political arena.

State: The sale of a SOTE brings in a large influx of money to the state, effectively reducing the national debt, and in cases where the SOTE was a drain on Treasury resources, eliminates these expenses. In addition, in cases where significant improvements to the telecommunications infrastructure were necessary, the sale of the SOTE removes the state from the position of financing those improvements.

The sale of the SOTE to a foreign telecommunications company also brings improved service delivery, through cost-efficiencies which will naturally be implemented once emphasis is shifted from public policy to business criteria, the flow of imported technology to upgrade the current system and the implementation of responsibility and accountability into the business. Along these same lines, enhanced telecommunications services are more easily introduced through the imported technology and capital. The improved telecommunications structure, a critical part of every country's infrastructure, should also facilitate governments in attracting foreign investment into the country.

SOTE: Capital acquisition allows SOTEs with limited funds to significantly improve their current telecommunications service. Many countries have long waiting lists for the installation of new phone lines (see Figure 2), and no resources with which to implement a large-scale expansion of service. In some cases, rural areas of the country have no phone service or few phone lines into sparsely populated areas. The modernization or upgrade of current phone systems, such as the implementation of fiber optics or digital switches, is another expensive task which requires significant capital. And many SOTEs wish to introduce value added services such as E-Mail, EDI or enhanced facsimile networks, often requiring a significant influx of monies.

POPULARITY OF PRIVATIZATION

Unmet demand for telephone service

Singapore	none	Czechoslovakia	310,000
UK	none	Spain	365,000
Venezuela	61,000	Mexico	750,000
Malaysia	65,000	Greece	1,051,000
Australia	83,000	Turkey	1,337,000
Portugal	178,000	Poland	2,188,000
East Germany	217,000	USSR	23,000,000

Figure 2

The sale of the SOTE to a foreign telecommunications company can also bring to that country access to a significant source of telecommunications technology. For instance, Ameritech, is currently building an intelligent network through a more than $200 million investment in Signaling System 7 which will permit more efficient use of the switched access network, faster call set up and call completion, and a greater capability to support new services. This technological experience can be exported overseas to significantly improve a SOTE's infrastructure.

Another significant advantage to the SOTE is the removal of telecommunications issues from the political arena. A chief issue with many state-owned monopolies is a significant overstaffing of the operation. A quick comparison of countries' employee levels shows a significant disparity in the number of employees per phone line currently used to run the system (see Figure 3). The reduction of this staff could be a problem politically with potential clashes between the state and labor unions. Responsible buyers of SOTEs can provide unique solutions to overstaffing that are in the interests of both buyer and employee. Other possible troubles removed by privatization are the decisions regarding the markets or geographic areas which will be first to receive expanded or modernized phone service. Another advantage in removing political sensitivities from the telecommunications business, is a more consistent management and work force. Often, management personnel will change with each new change of political leadership, making long term strategy implementation difficult at best. By removing telecommunications service from the political arena, business decisions can be made without the encumbrance of political sensitivities.

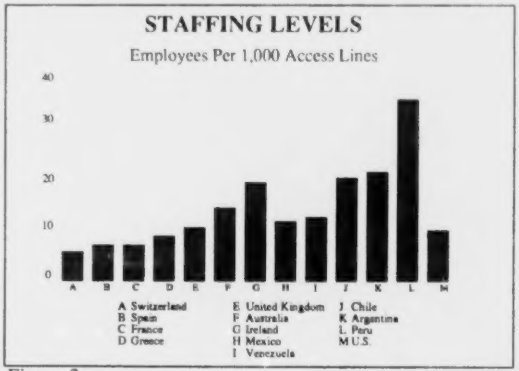

Figure 3

3.2.2 The Buyer's Perspective

From the buyer's perspective, privatization accomplishes four critical objectives: geographical diversification, expansion into other lines of business regulated in the buyer's country, expanded service to current customers through globalization, and increased shareholder value.

In today's uncertain economic environment, geographic diversification of the business is an important factor in better ensuring profit stability. Diversification into a number of global geographic areas can add a measure of protection against a recessionary climate in the home country.

For U.S. telecommunications companies particularly, an overseas expansion into lines of business forbidden or regulated in the buyers country is of significant benefit. Gaining experience in managing, marketing and operating those business lines as well as technology development could eventually prove highly valuable if regulations are eased at home.

With the increasing internationalization of companies creating multinational corporate structures, the geographic telecommunications needs of these major domestic customers increase significantly. The opportunity to diversify and gain access through management control in foreign telecommunication operations is a natural extension of a domestic market strategy to provide superior service to domestic customers.

Lastly, an investment in a SOTE at a reasonable price has the potential to create economic value, over the long-run, for a buyer's shareholders.

4.0 The Bid Process - The Buyer's Perspective

The bid process officially begins with a public announcement by the government calling for submissions of preliminary expressions of interest. These submissions are factual representations of potential buyers' telecommunications expertise and financial capability to bid and rarely require an indication of value. While non-binding, they provide the government with an indication of the extent of buyer interest and are necessary for buyers to qualify to progress to the next step of the process - formal due diligence.

4.1 The Due Diligence Process

The objective of the due diligence process is to assess the benefits and liabilities of acquiring the assets or the stock of the state owned entity by reviewing the past performance and existing condition of each line of business to be purchased. This review, while costly and complex, is necessary to obtain a thorough understanding of the new regulatory and competitive framework, and a view of the future economic environment in which each of the lines of business will operate, enabling financial pro formas for the entity as a whole to be generated. These pro formas form the basis of a discounted cash flow analysis which determines the maximum purchase price that a buyer can pay and still create shareholder value. The need for thorough due diligence is directly related to the extent to which the government is reluctant to provide representations and warranties. If a government demands (or prefers due to political expediency) not to assume any risk of liabilities subsequent to closing - as often is the case in privatizations - extensive due diligence will be required to protect the buyer's interests. Governments should note that failure to provide representations and warranties will lower the number and amount of the bids.

4.1.1 Preliminary Due Diligence

There are two stages in the due diligence process - preliminary and formal. Preliminary due diligence begins when the buyer becomes aware of the privatization opportunity - often prior to the public announcement - and starts to gather and review publicly available data about the SOTE from press reports and from required filings with local regulatory or governmental agencies. Generally, this information is quite limited and needs to be supplemented through direct discussions with SOTE and government officials. Through interviews of SOTE managers and access to internal SOTE documents a buyer can obtain insights into how the SOTE is run and how it could be restructured, with the buyers' assistance, to reach its full potential by improving efficiency and service quality, reducing costs, rebalancing prices, modernizing the network and introducing new services. In addition, discussions with government officials can provide preliminary views on the criteria which will be the basis for determining the winning bid. Often, buyers are solicited in these interviews for their views by the government which provides an excellent opportunity to help shape the sale process. Later in this stage, an offering memorandum, prepared by the government's advisors, will be available to the buyer. This document should contain few surprises to a buyer who has adequately preformed preliminary due diligence.

Although obtaining information on the SOTE's network and lines of business are central to a preliminary due diligence review, many environmental factors also need to be examined. Critical among these are the political, economic, and labor environments, and country demographics.

The political stability of the privatizing country is of critical importance to prospective purchasers. Factors that need to be examined are the popularity of the current regime, the strength of the opposition, the general popularity of the concept of privatization, and attitudes toward regulation. The risks faced in this arena are the possibility of renationalization of the telecommunications entity if another regime comes to power, or the possibility of ex-post-facto regulations which could be injurious to the newly privatized entity.

Economic stability is also a critical area to be examined. Factors to be explored are the current strength of the economy, the likely future environment, the major country industries and their global strength, the possible impact of an economic downturn on telecommunications revenues and the ability of the country to weather any major crisis, such as the current significant rise in oil prices.

The current environment for labor is another area that bears examination. First to be considered is the stability, education and skill levels of current or potential telecommunications workers and management and the volume of suitable prospects available. A second factor is the status of labor relations, such as the strength of labor unions, their attitude toward privatization, and the regulatory restrictions regarding labor. A third factor in this examination should also be an analysis of the company culture, to ensure that there are no insurmountable differences in style.

The consumer and business demographics of a country are also areas which should be closely examined to determine whether enhanced telecommunications services are likely to be attractive. Critical among these for consumers are disposable income, orientation to technology, and buying patterns. For businesses, volume of telecommunications use, the presence of computers and again orientation to technology will be critical. Without a careful analysis, demand for enhanced services could fall far short of projections and damage profitability.

4.1.2 Formal Due Diligence

Formal due diligence, as noted above, is a stage that only qualified buyers are invited by the government to enter. This stage is administered by the government's financial advisors who seek to expedite the process and control access to SOTE information. Buyers are generally limited to presentations by SOTE senior management and scheduled access to a data room containing approved SOTE documents and limited visits to operations' sites. Often, certain information available during preliminary due diligence is now considered "proprietary." It is because of this limited availability to information in this stage that preliminary due diligence is so critical for a buyer to adequately perform. Since the time available to a buyer to perform these functions is also limited, it is critical that a sufficiently large and focused due diligence team be assembled and managed as efficiently as possible.

The largest component of due diligence expense is staffing. The due diligence team assembled for a Telecom privatization would include representatives from many disciplines (see Figure 4). While the majority of the members of the due diligence team can usually be staffed by employees from partner organizations, it often is advisable - and sometimes necessary - to supplement the team with local advisors, usually, in the legal and financial areas. Upon successful completion of formal due diligence, a buyer will be in a position to submit a formal bid.

DUE DILIGENCE AREAS

EXTERNAL AFFAIRS
- REGULATORY
- GOVERNMENT
- CONSUMER

LEGAL

HUMAN RESOURCES

FINANCE
- ACCOUNTING
- TAXES
- TREASURY

NETWORK*

MARKETING*

OPERATIONS*

* BY LINE OF BUSINESS

Figure 4

5.0 Structuring the Transaction

The transaction structure for any given acquisition can be defined as the make up of the members of the consortium, the percentage of equity each member will hold and the source of the funding of the purchase.

The transaction structure of a consortium formed to purchase the assets or stock of a state owned entity is shaped by the following factors:

1) Government limitations on foreign ownership, both at time of purchase and over the long-run. Governments need to be aware of the fact that the greater the limitation on foreign ownership, the lower the bids and the ultimate purchase price will be.

2) Required capital, including purchase price and capital expenditures.

3) Required technology and operations expertise necessary to evaluate and run the entity.

6.0 The New Zealand Experience

6.1 The Move to Privatize

New Zealand was somewhat unique in that it initiated all three major stages (i.e., Separation, Corporatization and Deregulation) simultaneously as it moved to privatize its state owned telecommunications entity.

Up until March 31, 1987, virtually all telecommunications services in the country were provided by a government owned and operated monopoly, the New Zealand Post Office. On April 1, 1987, the three operating divisions of the Post Office - Telecommunications, Postal and Banking - were established as separate State Owned Entities. At the same time, Telecom was incorporated as a limited liability public company under the New Zealand Companies Act of 1955. Also in April, the government initiated a program to progressively deregulate the telecommunications market. Total deregulation of telecommunications was accomplished by April 1, 1989 - a mere two years later. The New Zealand government chose to privatize Telecom by a private sale of shares to a strategic investor. The government's basic premise was that a strategic investor would be willing to pay a premium over the proceeds available from a public offering. On February 23, 1990, Telecom was publicly put up for sale by tender.

6.2 Key Objectives of Government in Offering Telecom for Sale

The government had several key objectives in deciding to offer New Zealand Telecom for sale. Foremost, it wanted to use the sale to reduce public debt - which stood at $ 35.9 billion on January 1, 1990 - and government debt servicing costs. Proceeds could also be used to effect a number of social services. It also believed that having Telecom in capable private hands would provide the most effective and efficient telecommunications environment considered essential for improving the ability of the nation's various economic sectors to compete effectively worldwide and thereby leading to a higher future standard of living for New Zealand.

In March 1990, the government announced three additional criteria which would have a significant impact on the transaction structure of any bid:

- A ceiling of 49.9 % on the shareholding of any foreign strategic buyer. The remaining 50.1 % would be sold by the government in a future public offering.

- A requirement that at least NZ $ 500 million worth of shares must be made available by public offering on the New Zealand market.

- The government's intention to retain control of the maximum shareholding of any single foreign party and transfers of blocks of shares among parties; and to ensure Telecom's advertised commitments for residential services remain in place.

Ameritech was one of 19 parties who submitted an expression of interest on Telecom and received an information memorandum in April, 1990.

6.3 Why Ameritech Was Interested

6.3.1 Privatizations Are Attractive

SOTE privatizations are a key component of Ameritech's growth strategy. Numerous studies of cross-border acquisitions have indicated that successful acquisitions are directly correlated to the share of market purchased. The acquisition of a state owned telecommunications entity providing dominant - and often 100 % - market share is an ideal entry investment vehicle into the country. Ameritech has made commitment to pursue SOTE privatizations - businesses that it knows best - in attractive markets around the world. The number and diversity of SOTE privatizations that will be available during the next five years affords the opportunity to be selective about the ones in which to participate.

6.3.2 New Zealand's Attractiveness For Foreign Investment

New Zealand is an attractive market for foreign investment because of five factors: political stability, commitment to economic reform and liberalization, existence of a highly educated work force, sound demographics, and proximity to other markets.

New Zealand's political stability substantially reduces the uncertainty and risk associated with substantial capital investments. In 1984, New Zealand initiated numerous economic reforms and has consistently demonstrated a commitment to free enterprise and privatization, and a willingness to allow significant foreign ownership. The government has sought to establish a business environment to attract foreign sources of capital, new technology and management expertise. There are no restrictions on repatriation of capital or remittance of profits, dividends, fees, interest, and royalties. It has a stable free-floating currency enabling efficient convertibility of foreign currencies and the use of hedging techniques to temper the impact of currency fluctuations.

With a country literacy rate of 99 percent, New Zealand has one of the world's most educated and highly trained work forces providing a skilled labor pool necessary for the success of high-technology businesses in today's global economy.

In addition, labor unions have proven flexible in adopting to the changes brought about by earlier privatizations and other economic reforms. While GDP per capita growth has been modest, the country also has relatively high per capita and disposal incomes. Consumers appear to be willing to adopt new technology.

Moreover, New Zealand's high urbanization rate (84 % versus 74 % for the U.S.) makes it an attractive market.

Lastly, New Zealand's geographic location positions it as a base for further geographic expansion of businesses into the larger markets of Australia and the other Pacific Rim countries.

6.3.3 Telecom New Zealand Is An Attractive Privatization Opportunity

In addition to the healthy political and economic environments discussed above, investment in Telecom New Zealand was an attractive opportunity because the company had made great strides in positioning itself for privatization. Unlike some SOTEs, which enter privatization unchanged from their condition as a regulated monopoly, Telecom had

Unlike some SOTEs, which enter privatization unchanged from their condition as a regulated monopoly, Telecom had

transformed itself in the three years since corporalization by significantly modernizing its network, reducing staff and rebalancing its prices for the new deregulated environment (See Figure 5). Furthermore, a capable and professional management staff was engaged.

Telecom will provide Ameritech with significant strategic benefits. The first is the valuable experience it can gain by immediate participation in services it is currently restricted from in the U.S. Not the least of these is the international toll business. The second is that Telecom's pro-competitive totally deregulated environment provides Ameritech a valuable learning opportunity, as local telecommunications markets in the U.S. become increasingly deregulated and open to competition. Lastly, Telecom can serve as a springboard to other telecommunications opportunities in the Pacific Rim.

TRANSFORMATION OF TELECOM NEW ZEALAND

	1987	1990
Total Telecom staff	25,600	15,530
Customer lines/operating staff	65	120
Digital switching	20 %	90 %
Toll price reductions	-	> 50 %

Figure 5

6.4 Due Diligence

Ameritech began preliminary due diligence on Telecom New Zealand in October, 1989 and continued into formal due diligence which began in April, 1990. During these seven months, Ameritech was able to obtain significant information on Telecom New Zealand's operations, as well as the New Zealand economic and political environments.

Formal due diligence was a joint effort with Ameritech's three consortium partners, each of whom contributed employees to staff the due diligence team. The team consisted of approximately forty partner employees and an equal number of outside consultants - primarily legal and financial. While prospective bidders were initially scheduled for one day of presentations by Telecom senior management and three days of access to Telecom documents in a data room, additional access to both management and the data room was provided, on a tightly scheduled basis for an additional 3 weeks. In addition, team members were allowed scheduled on-site visits to Telecom facilities. Such a large team required a great deal of coordination and focus but was necessary to meet the government's objectives for a "clean" sale with no representations on warranties provided to buyers.

6.5 The Transaction Structure

Ameritech bid in a consortium consisting of four partners including Bell Atlantic and two local companies - Fay Richwhite Holdings Ltd. and Freightways Ltd.

Ameritech and Bell Atlantic decided to bid jointly because both companies had become aware of the government's preference to be relieved of its future obligation of selling 50.1 percent of Telecom in a public offering. Joining forces would provide the resources to bid for 100 percent of Telecom and share the responsibility for the future public offering. Freightways and Fay Richwhite were two of only a very limited number of local companies which had the interest and ability to invest in Telecom. Their inclusion in the consortium and future investment (Figure 6) would relieve Ameritech and Bell Atlantic of a portion of the public offering responsibility and provided local expertise in how to conduct business in New Zealand.

CONSORTIUM OWNERSHIP STRUCTURE

	Ownership at Closing	Eventual Ownership
Ameritech	50.00 %	24.95 %
Bell Atlantic	50.00 %	24.95 %
Fay Richwhite/Freightways	-	10.00 %
Public Ownership	-	40.10 %

Figure 6

After having evaluated five bids for Telecom submitted on June 6, 1990, the New Zealand government announced the successful sale of Telecom to Ameritech and its three partners.

6.6 Why Ameritech Was Successful

Ameritech was successful in its bid for Telecom for a variety of reasons:

1) Ameritech became aware of the opportunity and began preliminary due diligence well before the government publicly announced its intention to sell Telecom. This gave Ameritech sufficient time to perform a thorough assessment of the opportunity and to build the necessary commitment with its senior management. It also allowed it to become involved in discussions with potential local partners at an early stage and enabled it to gain far more insight than competing bidders about how Telecom was run and about what it would take to win the bid. Early involvement also enabled it to solve the significant U.S. regulatory issues that needed to be resolved to allow it to make a non-contingent bid.

2) Together with its consortium partners, Ameritech was able to conduct a well organized and thorough formal due diligence effort. This, combined with the strategic intelligence gained from preliminary due diligence enabled it to submit a bid which was far more responsive to government decision makers needs than any other competing bid.

3) Ameritech was part of a consortium with the right mix of partners. Ameritech and Bell Atlantic provided the telecommunications expertise and financial capability necessary to bid for 100 % of Telecom. the consortium with local content that made selling 100 % of Telecom, a national asset, politically acceptable.

4) Lastly, while Ameritech and its partners negotiated aggressively with the New Zealand government, it always had absolute respect for New Zealand's sovereignty and culture in all of its communications.

7. Conclusion

For buyers, privatization of a SOTE represents a once in a lifetime opportunity which cannot be ignored. The opportunity to diversify and gain access through management control in foreign telecommunication operations can be viewed as a natural extension of a domestic market strategy. Acquisition of foreign telecommunications carriers not only provides a potentially highly lucrative expanded local revenue base, but allows companies to expand their management and technical expertise into the realm of long distance and international services. Privatizations present buyers with the potential to create shareholder value. In its valuation process, buyers must be diligent in performing thorough due diligence as early as possible to be in the best possible position to assess the benefits and liabilities of a given privatization. While buyers have the right to negotiate during the bid process the best terms and conditions for their shareholders, buyers have both the incentive and obligation to respect the objectives of the state. States must recognize the trade-offs between maximizing the sales price for the SOTE and achieving political, social and marketplace goals. While the road to privatization has many twists, recent experience has demonstrated that states that acknowledge these inherent conflicts, and establish the appropriate guidelines for dealing with them, can indeed be successful.

8. Sources:

BIS MacKintosh Ltd. - London, UK

CS First Boston

Organization for Economic Co-operation and Development. Performance Indicatiors for Public Telecommunications Operators. Paris, France, 1990

Raul L. Katz. Telecommunications Privatization: A New Agenda in the Developing World (Booz-Allen & Hamilton Inc., 1990)

Telecommunications Research Centre. "Opportunities." Telephone News 1 Oct. 1990 - London, UK

Restructuring of Korean Telecommunications Industry

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1. Abstract

Korean government had announced the basic directions for restructuring of the telecommunications industry in the second half of 1990. Here is outlined the main points of this basic direction, e.g., the classification of carriers, the respective liberalization direction and the measures to be scheduled for implementation, which consists of step one and step two.

2. Background

2.1 Achievements in the 1980s.

Despite the surprising economic growth in the 1970s, the Korean telecommunications industry was relatively underdeveloped. By the turn of the decade, the Korean government began taking necessary steps to reshape and strengthen the telecommunications industry. In the past, the Ministry of Communications was responsible for both policy-making and provision of services. Under the current system, the Ministry is still in charge of the policy-making while services are provided by independent carriers. In other words, Korea Telecommunications Authority became independent in 1982 and is providing plane old telephone services.

As part of the plan to foster proper carriers in new media sector, DACOM was established in 1982 for the exclusive supply of data communications. Korea Mobile Telecommunications Corporation(KMTC) and Korea Port Telephone(KPT) have been set up, in 1984 and 1985 respectively, to provide cellular communications and port communications respectively.

Due to joint efforts from both the government and the carriers, basic telecommunications industry has witnessed a remarkable development. As a result, the problem of subscriber line backlogs, being the most pressing task in the Korean telecommunications, has been resolved and the national telephone system became fully automated.

2.2 Changes in Domestic and International Telecommunications Industry.

Rapid development of telecommunications technology has decreased cost of installing facilities, and sufficient supply of telephone lines has raised the question of lifting monopoly in the telecommunications market, weakening the public aspect of telecommunications. Moreover, the combined usage of computers and telecommunications generated diversified demands that require more responsive services in providing communications services.

Meanwhile, deregulation movement in telecommunications industry led by the US, Britain, and Japan is gradually extending to the rest of the world. In addition, the government is planning to privatize KTA by taking a step-by-step decrease in its shares of total investment. In this connection, there has been emerging the need of opening of the telecommunications market.

2.3 Search for New Direction

Such environmental changes made it necessary to reshape the telecommunications industy. In other words, the principles of market economy had to be introduced to upgrade the competitiveness of Korea telecommunications industry, and to meet the demand for new media services in the value-added sector. Furthermore, in order to foster independence and expertise of carriers, the government is moving towards deregulation.

3. Future Direction and Classification of Carriers

3.1 Future Direction

By taking into account the degree of natural monopoly, the speed of technological developments, and the demand for various services, the government has outlined the form of competition by areas.

Local telephone operations that require large-scale facilities will continue to remain under the monopoly of KTA. Gradual competition will be allowed for long-distance and international services, as well as mobile communications that relatively need small-scale investments with fast technological changes. Full competition is expected in the value-added sector where diversified services are needed.

3.2 Classification of Carriers

At present, carriers in the Korean telecommunications industry are divided into public telecommunications operators and information service providers. Public telecommunications operators, such as KTA, DACOM, KMTC and KPT can provide telephone, telex, fax, and packet switching services, or basic services.

Basically, KTA had been responsible for overall telecommunications, DACOM for data communications, KMTC for mobile telephone and paging services, and KPT for port communications before the recent restructuring of Korean telecommunications industry. KTA could not provide the services of other carriers.

According to the policy declaration by Ministry of communications, carriers are reclassified in terms of market characteristics, business areas, and tariff regulations. Depending on the ownership of facilities and types of services provided, carriers that can provide basic services with direct ownership of the transmission and exchange facilities are classified as the infrastructure telecommunications service provider.

The ones that provide value-added services with leased facilities as the value-added service provider. Again, the infrastructure telecommunications provider is divided into general common carrier that can provide basic services like telphone, telex and leased line services, and special common carrier with limited services based on the differences in business areas, types of services, and technical features. (Table 1)

<Table 1 : Classification of Carriers>

Carrier	Infrastructure Telecommunications Service provider		Value-Added Service Provider
Class	General Common Carrier	Specialized Common Carrier	
Business Area	-Telephone -Telex & Telegraph -Information Services -Leased Lines	-Land Mobile -Aircraft Mobile -Maritime Mobile	-DB/DP -Data Store & Forward -Data Process & Forward -Other Value Added Services
Entry Condition	-Designation or -Legislation	-Approval	-Registration
Type of competition	-Duopoly	-Limited	-Free

4. Structural Adjustments of Each Carrier

This section will examine specific plans for restructuring each carrier in the telecommunications industy.

4.1 General Common Carrier

General common carrier refers to operators that can provide telecommunications services equipped with facilities of national scale. In respect to the Korean market size and the efficient use of telecommunications resources, general common carriers will operate under limited competition. In order to enter this market, carriers must be designated by the Minister of Communications or the legislation. In the designation process, the Minister is to assign the business area.

As national supplier of basic telecommunications services, the capital structure of general common carrier will be regulated. Considering the fact that telecommunications business should be neutral, an individual firm can not hold more than 10% of the total shares and foreign participation is prohibited.

In return for the exclusive right to provide basic services with national transmission facilities, general common carrier has the obligation to establish efficient national telecommunications network and to provide equitable services nationwide. By the same token, in order to develop advanced technologies and to strengthen its competitiveness, carriers are also responsible for research and development.

Although competition is introduced in the general common carrier sector, the question of creating proper regulatory environment in which a new carrier can actually compete with dominant carriers — such as KTA — needs to be addressed first. For only actual competition will secure efficiency in the Korean telecommunications industry and will fulfill the user's need for high quality, and diversified services. In this context, although KTA will maintain its present operation(provision of all local, long-distance, and international services) for the time being, continuous efforts will be made to establish fair conditions for competition. By taking market conditions and competitive achievements into account, the government plans to review the structre of KTA in 1995. Currently, KTA has the duty to provide universal services of telephone and telex. However, the range of this duty is also expected to be revised in 1995.

4.2 Specialized Common Carrier

Specialized common carriers are organizations with facilities for their operations and they can only provide limited services due to the nature of business areas, types of services, and technical applicatons. Presently, Korea Mobile telecommunications Corporation and Korea Port Telephone that provide mobile telephone and port communications services respectively fall into this category.

Specialized common carriers sector will run under dual competition by adding a new participant. Afterward the number of new participants will be increased in relation to the market size and liberalization trend. In order to enter this market segment before the revision of the current telecommunications law, carriers must be designated as public telecommunications operators by the Minister of Communications. After the revision, carriers can operate with the approval of the Minister. Types of services and service areas will also be assigned in the approval process. The carriers can use transmission facilities for their operations only and the facilities cannot be sold. An individual firm's or person's shareholdings cannot exceed one-third of the total. The total amount of foreign capital should not exceed more than one-third of the total shares.

4.3 Value-Added Service Provider

Although information service providers, approved by the Ministry, had been rendering value-added services such as DB, DP, E-MAIL and EDI, they had been regulated in terms of services provided and facilities possessed. However, due to strong demand for diversified services and merging of computers and telecommunications, deregulation has been considered to take place in this sector first. Accordingly, by reclassifying them as the value-added service providers, the Ministry is going to introduce extended competition. Before this restructuring, approval of the Minister was required for operation. However, only registration is necessary for operaton(domestic operations only) now.

Business areas for this sector cover all services except just telex and telephone. Areas of operation is to be divided into domestic and international under different regulations. In terms of capital structure, participant's shareholdings is not limited. As far as foreign investment is concerned, liberalization will take place gradually in respect to the principle of reciprocity with the foreign country. Lastly, in order to guarantee fair competition in the value -added sector, infrastructure telecommunications service providers taking part in the value-added sector will be required of accounting or structural separations.

4.4 Establishment of Control and Coordination Body

Restructuring of the telecommunications industry will increase the number of participants, thus making it necessary to control them and to settle various disputes. For such purposes, the government intends to organize a so-called telecommunications arbitration committee. The committee is to coordinate business areas of each carrier, to arbitrate and settle disputes between the existing carriers and the new participants, or among new participants, and to prevent or control unfair practices of carriers, especially those of dominant ones. In addition, the committee has the duty to devise condition for interconnection of different networks, to examine and adjust condition for the open networks, and to settle disputes between users and carriers.

5. Progressive Plans for the Restructuring

So far, the focus of this paper has been on the future directions of the Korean telecommunications industry. From now on, specific government implementation plan for the restructuring will be examined.

5.1 Plans under the Present Law (Step One)

Since the latter half of 1989, the government has taken steps to accomodate limited competition under the current law, which will remain till next legal revision takes place in 1992.

5.1.1 General Commonn Carrier

In the general common carrier sector, apart from its sole operations of data communications, DACOM was allowed to participate in the international voice services(international telephone and international leased line). Likewise, KTA can now participate in data communications sector. In the domestic scene, however, KTA is the exclusive supplier of domestic telephone and leased line service for voice and DACOM is the exclusive supplier of domestic leased line service for data.

5.1.2 Specialized Common Carrier

The first step to be taken in this sector is to designate a new airport telecommunications carrier. This carrier will provide services within the airport. The project will be in the form of a consortium of KTA, airline companies, and other related companies. An individual firm's shareholidings cannot exceed ond-third of the total amount. After the review by the government, this plan is to be implemented in the first half of 1991.

5.1.3 Value-Added Service Provider

Value-added services sector has opened to more extended competition by deregulating the sector and by expanding business areas simultaneously. In this context, the ordinances and regulations of the revised Public Telecommunications Business Law effective January 1, 1990 have been drawn out at the end of last year. In domestic area valued-added services are considerably deregulated. That is, the supply of domestic DB and DP services is fully liberalized and deregulated. Other domestic value-added services can be provided only with the registration of Ministry of Communication. For the approved services, packet switching facilities can be equipped and approval is not necessary for the MUX below 2Mbps.

Continuous deregulation in this sectors will take place in the following manner. In case of international DB and DP services, deregulation is expected to take place in July, 1991 under registration system. Furthermore, value-added service provider will use its unique protocol network and be free of the duty to provide universal services.

5.2 Plans under the Revised Law (Step Two)

In order to carry out the restructuring, amendment of the laws regarding telecommunications must first take place. Telecommunications laws are scheduled for reviews and they will be amended by the second half of 1992 for the purpose of creating proper environment for competition in each sector classified in the restructuring. Step two plans for each sector are as follows.

5.2.1 General Common Carrier

In this sector, limited competition will continue for a while. Basic plan is to designate additional participants when necessary or to expand the range of competition by taking the market setting and competitive conditions into account. KTA and DACOM will be classified as general common carriers under the revised law. Considering the result of competition in international services sector during the step one period, long-distance services will be opened to competition and it is decided whether DACOM will be able to participate in the long-distance services sector. Additional designation of participants might be permitted when necessary in respect to the outcome of step one competition.

5.2.2 Specialized Common Carrier

Measures to transform KMTC, KPT and the newly designated airport telecommunications carrier that supply geographically and technically limited services into specialized common carriers will take place in this step. Business areas of mobile services where substantial growth is expected will include mobile telephone, radio paging, mobile data and trunked radio system. The regulatory authorities are to designate new participants of each business area. Apart from KMTC, one more carrier will be designated for the provision of mobile telephone services. In case of paging services, mobile data, and trunked radio system, one carrier is to operate in one service area. New participants will be selected under uniform standard through open procedure. These carriers will be obligated to allocate a certain portion of their total turnover to research and development.

5.2.3 Value-Added service Provider

Information service providers that have been providing information and value-added services will be classified as value-added service providers and their business area will cover all services except telephone and telex. The foreign participation in the Korean value-added services market will be determined in respect to the results of the Uruguay Round.

Achieving Interoperability
with
Distributed Relational Databases

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1. Abstract

Future telecommunications networks will become more integrated and "intelligent" by the addition of general-purpose computer platforms and distributed relational databases. Data linkages among multiple-vendor systems with diverse applications is called "interoperability." This paper defines how data will be distributed among corporate and operations work groups with SQL transactions and relational databases. Implementation techniques will be described in the context of user-accessibility to computer applications and data that may be located anywhere in the telecom enterprise.

2. Introduction

Future service provider networks will become more integrated and "intelligent" by way of added computer logic and databases. This trend will be enabled by very flexible, general purpose computer-based platforms. Such platforms will be bases for service logic programs and their requisite databases as well as for operational support and service management functions.

The evolution toward future networks is analogous to thechanges that occurred in data processing when most early computers programs were designed and maintained as monolithic entities. Eventually these monoliths became layered with powerful operating systems, high-level programming languages for application development, and flexible database and data communications subsystems. These changes allowed for optimization of each subsystem so individually they made greater contributions to a wide-range of application program products. Similarly, future networks will utilize network data systems, high-level programming languages or graphics support systems, and database technologies to create, provision, and administer new and enhanced services. The remainder of this paper describes how data systems will be distributed among work groups and network elements through techniques of interoperabilty, and distributed relational databases. Such capabilities are important to telephone companies worldwide who want to remain competitive. Responding quickly to changing market demands with fast service enabling and dynamic provisioning will help to ensure their survivability. Interoperability helps to ensure this.

3. OSS Background

Operational support data resides in systems that allowtelephone companies to administer, provision and manage networks that deliver services to their customers. In both the U.S. and among telecoms in major worldwide countries, these systems have been mechanized over the past 30 years with mainframe, mini and micro computer systems capable of processing diverse applications and functions, and storing large amounts of data.

Worldwide, telephone companies share two common problems with operational support systems: first, each system is independent of others; and second, they run on multi-vendor platforms. Such systems were mechanized at different times on different computer products in response to different needs.

OSS's may be located at regionalized and central data centers where they can be managed by information service professionals. As such, the system interfaces are determined by traditional data processing standards. Other support elements are located at minicomputer centers or in central offices (telephone exchanges), or within individual work groups. Such systems may be small standalone configurations or larger clusters of fault-tolerant systems. Their interfaces may be radically different from each other, and consist of proprietary interfaces managed by specific groups of end users such as network operators and engineers.

All corporate and operational support data have one common denominator - they run on multi-vendor computer platforms. Data that is so important to day-to-day operations is structured in formats unique to the computer environment on which the system is implemented. Accessibility to this data is constrained to the work group that manages the system. Output in paper format from one system means that transfer of this data to another system must is via keyboard or other input method. Multi-vendor configurations are not conducive to electronically sharing data due to communications connectivity problems and data format incompatibilities. As such, there is no "interoperabilty" among them.

Today and in the past, sharing data via electronic means hasnot been a problem. This is because provisioning for basic telephone services does not require a high degree of interaction among the data elements in each of the operational support systems. By comparison, effective management and maintenance of future networks of tightly integrated computers and network elements will require data consolidation and distribution by electronic means.

The need to create new revenue services quickly, also, will require more interaction among support systems. Service creation benefits from having common source data in order to facilitate provisioning. Access to this data should be provided through end user as well as data processing interfaces.

4. Interoperability Among Operational Support Systems (IOSS).

IOSS is defined as a collection of interactive systems that support the provisioning and management of advanced telephone services and maintenance of complex networks. The systems should share common data records and use standard access methods.

An IOSS should link "islands" of mechanized systems thereby providing more effective automation of information flows. Such automation provides flow-through provisioning; allows for greater computer control over multiple and diverse operational data systems; and, improves network responsiveness while promoting the capability of the networks to "heal" themselves.

An IOSS maintains the image of a cross enterprise database of information selected from both corporate and operational data systems. The physical reality may be supported by a centralized database management system with multi-system access facilities. The objective is to ensure standardized control of data consolidation and distribution functions to support the operational side of the telephone business.

4.1 Challenges in Achieving Interoperability

Cost of data and system conversion, technical issues, and an apparent lack of standards are the three main challenges tosolving the problem of inter operability among operational support systems.

The high cost of rewriting the existing operational support systems is not the only element of cost. Just as important is the fact that many of these systems have not been fully amortized by the telephone companies. A gradual migration will be required, moving from today's predominantly stand alone support systems to fully integrated ones. The time required to do this means that companies may lose strategic business opportunities such as the introduction of new services and added network control capablilities.

A second challenge is that of providing standards by which operational support systems can be integrated into network platforms. Standard operating environments have been established largely for consistency in processing data center databases. Such standards should extend to the IOSS common databases to avoid coining new, unique descriptions for application software interfaces, data record elements and files, access methods, and updating procedures. OSI standards for programming systems apply as they become widely used within the telecommunications industry. At the same time, OSI communications and network management protocols will evolve to solve the problems of multi-vendor system connectivity. The physical links between systems in a distributed data network will migrate to broad band ISDN or other high-speed transport mechanisms. We assume that both OSI and ISDN are technological enablers for achieving interoperability among information systems.

Standard end-user interfaces also are necessary in order to make the user's job easier. End-users may benefit from programming tools or graphic-oriented workstations. Which method is standardized will be determined by human engineering studies.

Technical issues loom large as major road blocks to effectively achieving interoperability. The process of standardization is technical by nature, but other significant technical problems are the definition and selection of a suitable platform for the interoperabilty engine and subesequent data distribution mechanisms.

The financial, standardization, and technical challenges areinterwoven and need to be met simultaneously if inteoperability is to be achieved. The steps required to build such systems should be congruent with the challenges so that the business and technical problems can be solved in a planned, logical, and coherent fashion.

5. Data Networks & Relational Databases

Operational and corporate data contained in today's static databases must become a universal commodity to network operations people and managers so they may effectively manage complex voice and data networks.

Highly functional data retrieval and manipulation also is needed to support complex data requirements in integrated networks such as on-demand customer requests. Customization of service applications also requires that data be dynamic and retrieved on an as needed basis. This implies that data be portable among user applications, and that user data, whether local or remote, be easy to access.

Distributed data and applications are key to the interoperability of operational support and corporate systems. Programs that execute at one computer location should be able to access data or applications in a remote system. These needs can best be met with distributed processing techniques. The objectives of distributing data and applications are the following:

(1) data should appear local to the user,
(2) data distribution should be transparent to programmer and user, and
(3) data should be portable among applications.

There are two requirements to meeting these objectives: standard program requests across systems within a data network, and standard data coding. Meeting these needs ensures that data become an accessible end-user commodity for the management of complex networks.

A major drawback to distributing data and functions is the need to protect capital investments in existing systems. One way to do this is to migrate the data and functions in a planned and orderly process using existing systems. The objective of this migration is to give the appearance of a common database, standard data coding, and universal data accessibility across multi-vendor systems.

An architectural view is shown in Figure 1 of a logical,layered enterprise data network. The end-user layer may consist of either human operators or system applications both of which need access to operational applications and data. The generic application layer shows representative functions that may reside in one of more systems spread across multiple geographic locations. These applications gain access to data that is stored in various locations on different systems. Interoperability is the method by which this architecture functions in a day-to-day operational telephone environment.

End-user's access to remote data spread across a variety ofcomputing systems may be difficult due to the complexities of network programming. What is needed is a common method of overcoming the programming difficulties and ensuring that standard data and functions are available to all users on an equal basis. Distributed relational database management systems (DBMS) fulfill this need.

End-user systems in a distributed relational DRDB network are on a peer-to-peer basis. An end-user may be a telephone company employee located at different company organizational levels, for example, headquarters, district, or exchange office. An end-user also may be a telephone company's customer.

5.1 Distributed Data Tables

Relational databases by definition consist of data contained in tables. On the other hand, non-relational data is contained in files and records. Generally, non-relational data is more cumbersome to transport and process with procedural languages. A distributed relational DBMS meets more of the needs for standardization and ease of access, and is the method of distributing data that will be described in this paper.

A distributed relational DBMS is defined as a collection oftables in a network. These are spread across a number of different computer systems interconnected in a network. (Figure 2) Each computer has its own relational DBMS with which it manages its tables of application data. Multiple computer applications can be run concurrently with the distributed relational DBMS. The DBMS performs like a local software data gateway to the rest of the data network. It communicates with peer systems or to a centralized host relational DBMS using SQL (Structured Query Language). SQL isan international standard for transactions in distributed data networks. The physical link protocol is assumed to be X.25.

A relational database can handle a data request even if thedata is in another computer system. For example, if a user requests data not physically in his local system, his relational DBMS locates the data by referring to a data directory that specifies the location of the remote system in which the data resides. A standard request is passed from the originating system to the remote system. The remote database management system services the request, and returns the information requested to the originator of the request. (Figure 3).

5.2 Interoperability Engine

Periodically, distributed end-user computing systems may need to link to a central relational DBMS for more information. An "Interoperability Engine" (hereafter called the Engine) is the central storage location for consolidated and standardized operational and corporate data. The relational data is stored in a "Repository" and is the first major function of the Engine. Remote requests for user data that cannot be located in distributed network systems will be routed to the Repository for servicing. (see Figure 4). A "most frequently used" algorithm determines the probability that a remote user request can be serviced. The higher the probability of service, the more data that must be stored in the Repository. The percentage of time that specific data elements are available may be increased or decreased as desired by changing the algorithm.

Figure 1

IOSS/DATA NETWORK ARCHITECTURE

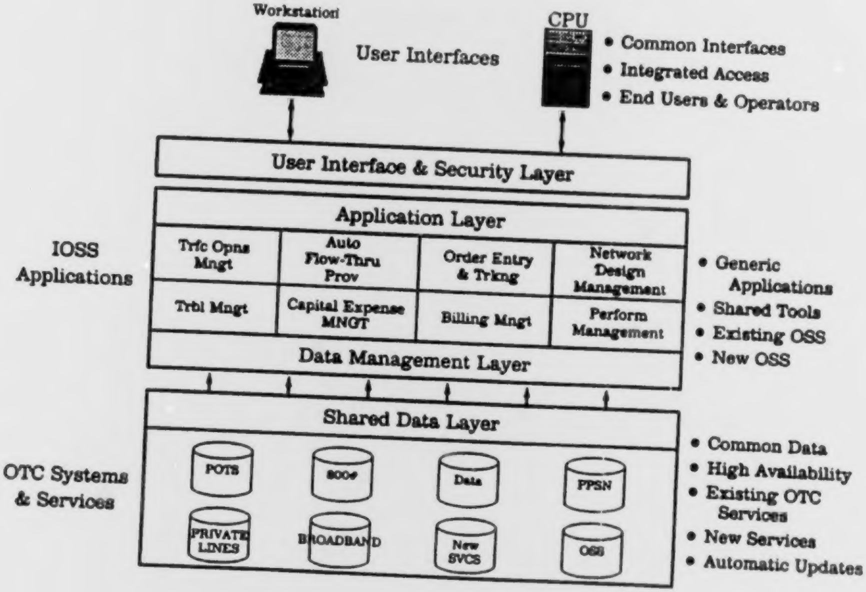

Workstation
User Interfaces
CPU
• Common Interfaces
• Integrated Access
• End Users & Operators
User Interface & Security Layer
Application Layer
IOSS Applications
Trfc Opns Mngt
Auto Flow-Thru Prov
Order Entry & Trkng
Network Design Management
Trbl Mngt
Capital Expense MNGT
Billing Mngt
Perform Management
• Generic Applications
• Shared Tools
• Existing OSS
• New OSS
Data Management Layer
Shared Data Layer
OTC Systems & Services
POTS
800#
Data
PPSN
PRIVATE LINES
BROADBAND
New SVCS
OSS
• Common Data
• High Availability
• Existing OTC Services
• New Services
• Automatic Updates

Figure 2 DISTRIBUTED RELATIONAL DATABASES

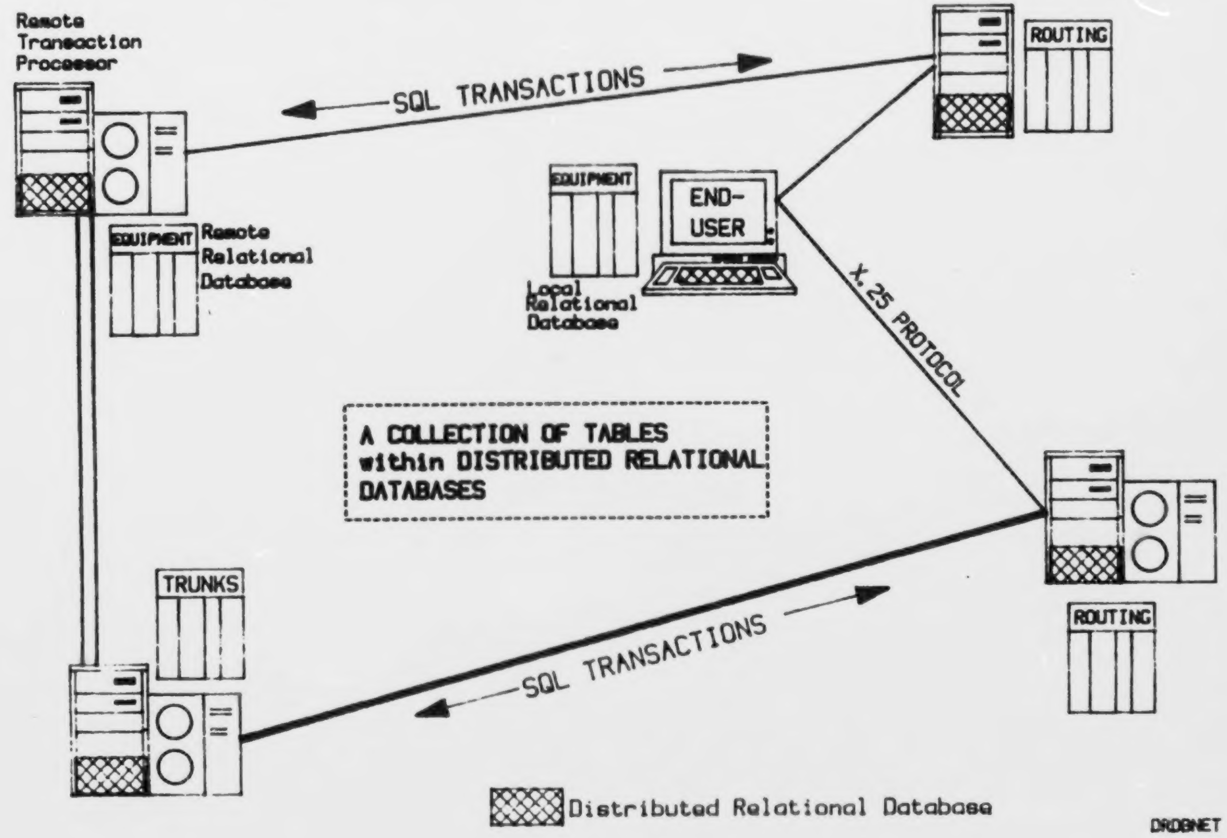

Remote Transaction Processor
SQL TRANSACTIONS
ROUTING
EQUIPMENT
END-USER
Remote Relational Database
Local Relational Database
X.25 PROTOCOL
A COLLECTION OF TABLES within DISTRIBUTED RELATIONAL DATABASES
TRUNKS
SQL TRANSACTIONS
ROUTING
▨ Distributed Relational Database
DRDBNET

Figure 3 DISTRIBUTED DATA NETWORK

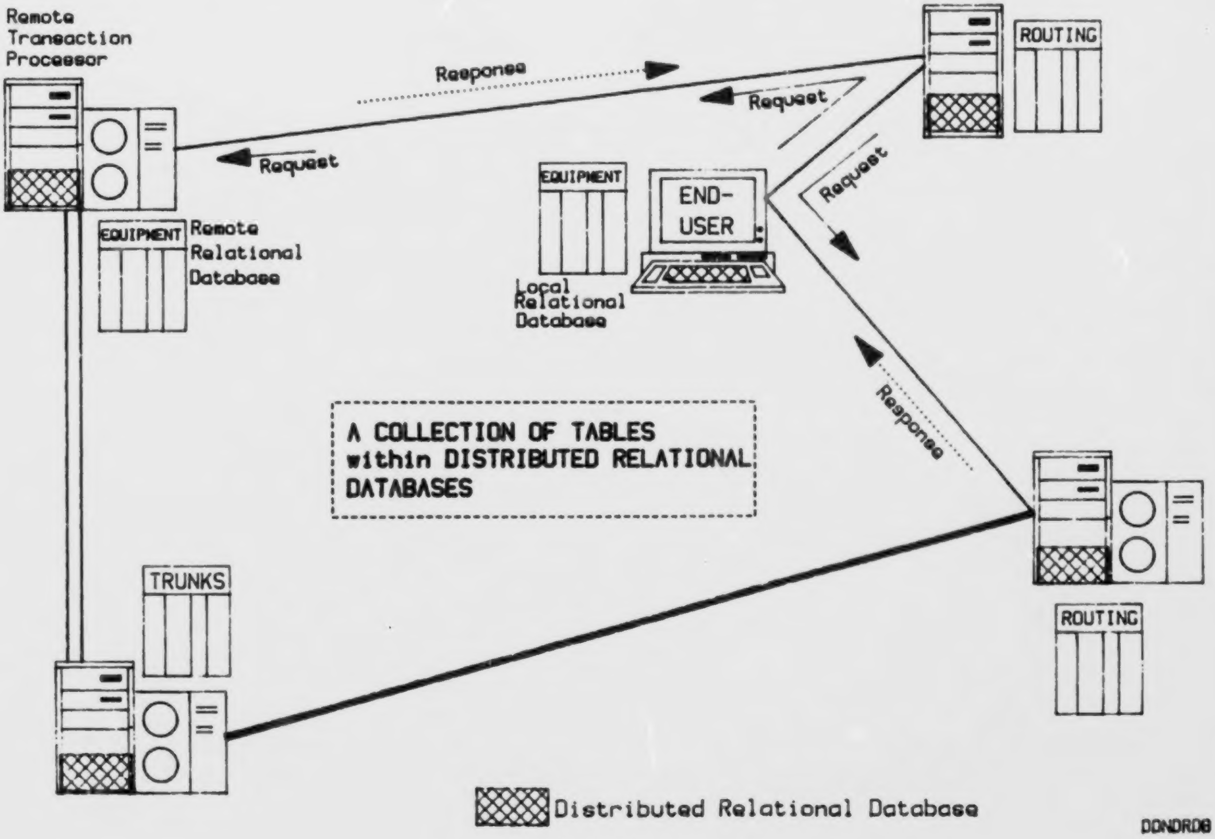

Remote Transaction Processor
Response
Request
Request
ROUTING
EQUIPMENT
Remote Relational Database
EQUIPMENT
END-USER
Request
Local Relational Database
Response
A COLLECTION OF TABLES within DISTRIBUTED RELATIONAL DATABASES
TRUNKS
ROUTING
▨ Distributed Relational Database
DDNDRDB

Figure 4

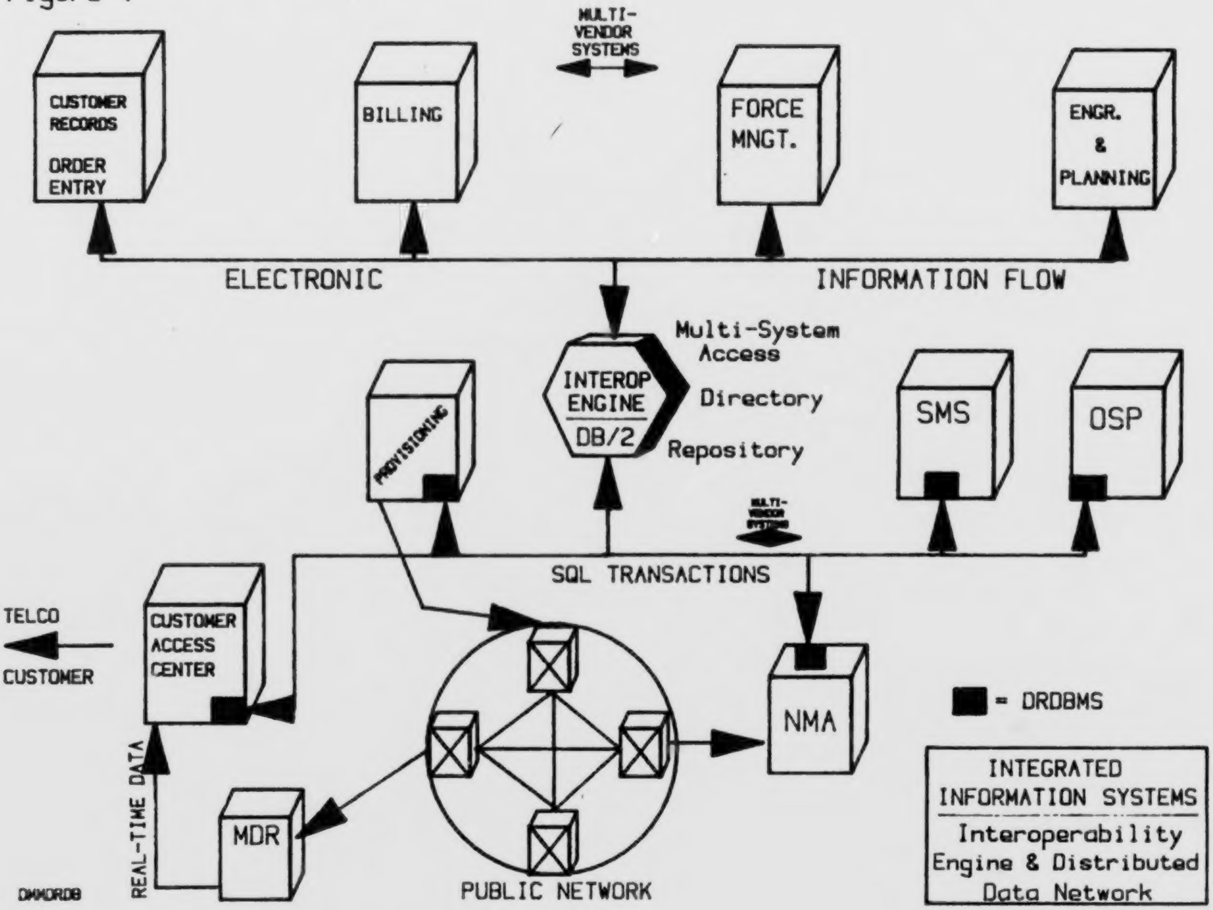
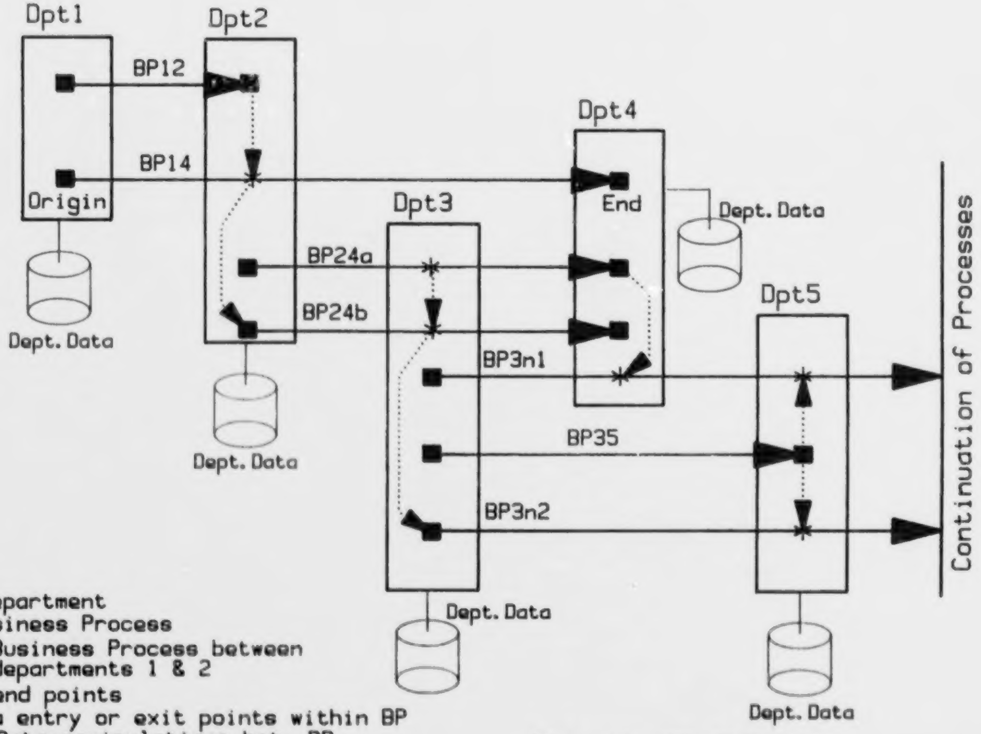

MULTI-
VENDOR
SYSTEMS
CUSTOMER
RECORDS
ORDER
ENTRY
BILLING
FORCE
MNGT.
ENGR.
&
PLANNING
ELECTRONIC
INFORMATION FLOW
Multi-System
Access
INTEROP
ENGINE
DB/2
Directory
Repository
PROVISIONING
SMS
OSP
MULTI-
VENDOR
SYSTEMS
SQL TRANSACTIONS
TELCO
CUSTOMER
CUSTOMER
ACCESS
CENTER
NMA
= DRDBMS
INTEGRATED
INFORMATION SYSTEMS
Interoperability
Engine & Distributed
Data Network
REAL-TIME DATA
MDR
DMMDRDB
PUBLIC NETWORK

Figure 5

RELATIONAL DESIGN METHODOLOGY©
ORGANIZATION BUSINESS PROCESS ANALYSIS


Dpt1
Dpt2
Dpt3
Dpt4
Dpt5
BP12
BP14
BP24a
BP24b
BP3n1
BP35
BP3n2
Origin
End
Dept. Data
Dept. Data
Dept. Data
Dept. Data
Dept. Data
Continuation of Processes

Legend:

DPT = Department
BP = Business Process
BP12 = Business Process between departments 1 & 2
■ = BP end points
* = Data entry or exit points within BP
···▶ = Data manipulations bet. BP

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RDMBPA

Ensuring that remote end-user data requests do not gounserviced, it is necessary that the Repository be able to request data from other multi-vendor systems containing operational or corporate data that are not part of a distributed data network. This can be done with a second function of the Engine called the multi-system access facility (MSAF). Data is selected from various multi-vendor systems via program requests that are system independent. Data so retrieved may be sent directly to a requesting end user or converted into a relational format (tables) for storage in the Repository.

Communications between the MSAF and Repository is via a "DataDirectory," the third major component of the Engine. The Directory contains entries showing the type, format, and contents of each corporate or operational system location to which access by the MSAF is permitted. In this way, data requests can span several multi-vendor systems and electronically transmit desired information to end-users in any work-group attached to the distributed data network.

5.3 Levels of Processing

Various levels of distributed database processing exist fromthe simple to the complex. A simple form or level of request is from a user workstation such as a personal computer to a host processing system with a relational database. The end-user requests data from a personal computer workstation without a relational database, and the request is passed from the workstation to the host by a software defined PC-host interface. A relational DBMS in the host processes the request and sends the appropriate data back to the requester. Such requests are generally one time or random occurrences. More complex, higher level transactions are described as "distributed units of work (DUW)." The purpose of the DUW is to read and update data at multiple locations within a single unit of work. For example, suppose a need exists for a single transaction to read data from several different tables in physically different and geographically remote systems, and update data tables in a third system. These systems may be either host processors or within distributed data networks. The distributed relational DBMS should handle this request as a single transaction from the first read through the updating process.

5.4 Relational Database Processing

Four other distributed relational database processes are extracts; snapshots; data replication; and distributed table processing.

5.4.1 Extracts: these are user-requested copies of tables that are used one-time or repeated periodically. Extracting is used for migrating data into new formats and maintaining read-only data tables. The main advantage is increased data availability.

5.4.2 Snapshots: read-only copies of data tables are automatically refreshed by a host database. Periods of refresh are daily, weekly, and monthly as required by the user. The main advantage of snapshots is to reduce requests for data by updating frequently used data automatically.

5.4.3 Data Replication: after updating key tables, user-locations can initiate the replication of the data throughout the network. In this way, all users needing data have up-to-date copies. For example, as new network services are created and data tables changes at the creator's location, these changes can be sent automatically to all other locations needing this information. In this way, requests for the most frequently used data are more quickly serviced by a local database.

5.4.4 Distributed Tables: in certain situations, data tablessplit across more than two locations need to be consolidated at a single point. A user can request the data from multiple locations and sum it on a new table. The resulting new table can be used to enhance network management or for better service distribution planning.

6. Implementing Distributed Relational Databases

Distributing relational data among departments requires a detailed analysis of how data is used within an organization to support business processes. All telephone companies consist of operational business processes such as service order processing, billing or service activation in support of business objectives. These objectives may include improving customer satisfaction, increasing revenue, or faster service provisioning. Business processes are not limited by one department but "flow-through" several. Data originated, used, or produced by the processes occurs at different times and locations within the process. The objective of a Relational Design Methodology (RDM) is to identify and describe the business processes and their supporting data (Figure 5), schedule an implementation plan, and design the physical relational databases and detailed business transactions.

An Information System Study (ISS), Plan (ISP), and Design(ISD) are the three components of the RDM that result in the definition and implementation of transactions and a relational database. Business processes are analyzed from information drawn from interviews of the people who actually perform activities in the processes. Within a company, a typical ISS may define 125 to 150 processes and their associated data.

The study groups business processes on their "data classes."These classes are "packets of information" used by a process like customer number or service type. A data class is created by one process but may be used by many. As many as 200 to 250 data classes may be defined in the study. Data classes are further defined by when and how they are created and used within a process. Groups of business processes are grouped according to their use of data classes and designated as "subsystems."

Each subsystem is ranked in an implementation sequence by an Information Systems Plan (ISP). This ranking is dependent on the judgement of management within the organization. Managers review an implementation sequence for the processes within a subsystem using the criteria of "development efficiency." This is the least-cost order of development and is based on the order in which data is created. Thus, processes that create data (as opposed to just using data) should be implemented first.

The ISP clarifies the scope of effort for each process, selects individual or groups of processes whose data is suitable for relational databases, and defines application projects. These implement the processes in a subsystem in a defined sequence using relational database development tools. Each application project may be implemented in segments. Each segment may be designed, built, and implemented independently in series or parallel so as to accommodatechanges in management's priorities during the implementation effort. The Information Systems Plan must ensure coordination and frequent review by management and project teams so that workable subsystems result.

The third component of the Relational Design Methodology (RDM) is the Information System Design (ISD). In the ISD, the relational database and required business transactions are designed for the application projects. The three level construction of information systems is based on standard techniques described in the ISO TC97/SC5-N695 of March, 1982. The levels are called "Schema": Conceptual, External, and Internal. The first schema defines the information content of the database, allowable states, and the rules governing changes to the states. The second schema describes the way users and application programs use and maintain the information, and the last schema defines the physical implementation of the relational database and the transactions required.

The conceptual scheme design analyzes the output required of a specific application project as a way to define the information required by the subsystems contained in the project. For example, a telephone service order clerk needs customer information (number, location, services used, et al) from a database delivered via computer screens as support for the service order process. Data analysis techniques are used to understand the information relationships needed to deliver these outputs to the service order clerk.

The external schema design describes the creation, use,update, and deletion (manipulations) of every piece of information required by subsystem users. An "event-trigger"type of analysis is used for these descriptions. Business transactions are defined by grouping those manipulationstriggered by the same user event.

A step-by-step design of a physical relational database and the requisite business transactions are the output from the internal schema design portion of the Information System Design. Detailed specifications for an efficient physical relational database as well as the Structured Query Language (SQL) transactions are written. The database and transactions designs are tuned for performance in a priority order when transaction service levels are established and performance criteria set.

Service levels include reliability, availability, security, and currency of data as well as transaction performance (responsiveness and total time). Physical database and transaction design is also based on the placement of data among departments and individual users. Some factors that must be considered are the ownership of the data; characteristics of the user; rate of data manipulation; and data volatility.

6.1 Summary of Implementation

A Relational Design Methodology is used to analyze an organization's business processes as a way to identify where data is created, manipulated, and deleted by business transactions. The outputs of the methodology are the implementation of physical and logical relational databases and SQL transactions. Information Systems Studies, Plans and Designs include the techniques required to analyze, schedule, and implement application projects using distributed relational databases. In this way, telephone companies can achieve interoperability among operational support systems.

Customer Management System For Satellite Business Services

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Gloucester, Ontario,
Canada K1B 5P4

Abstract

Provision of control options to customers to configure and manage communication networks and services has become very important for various reasons. The evolution of bandwidth-on-demand(BOD) system has been driven by this need. The inherent modularity and flexibility of satellite systems are ideally suited to a BOD network architecture. Satellite-based BOD networks are already in operation in North America. This paper describes various elements of a BOD network. Emphasis is given to the customer management aspects of the system. Efficient bandwidth utilization and allocation techniques are discussed. Where necessary feautres of a BOD system (SNS-1000) developed by Telesat Canada are highlighted.

Introduction

The much awaited Customer Control & Management of communication networks is becoming a reality. Provision of direct control options to corporate users have become an important factor for market penetration and cost saving. In North America, some satellite service providers have already started providing customer controllable services to business users through a bandwidth-on-demand (BOD) network. While premise-based satellite earth station networks provide 'Total Bypass' solution, the customer management system(CMS) associated with a BOD network provides the user virtually total control of the network facility and services.

Satellite networks supporting BOD services could allow the corporate users to choose the time of transmission(immediate or advance booking), destination site(s), network topology, and a wide range of data rates (also refered as bandwidths). The customer will be able to administer cost control from the usage information available at the CMS and be able to know the health and status of the network when required. Corporate clients can access bandwidth from a shared common pool or can set up their own multi-service virtual private network (MVPN) sharing bandwidth amongst their nodes.

This paper will discuss concepts, technical issues and features of satellite communications Network Management System(NMS) developed for the provision of BOD services. Several networking and applications scenarios in which both domestic and international business satellite communications users can use such an NMS system to support a wide range of applications including video conferencing, disaster recovery, file transfer and image communications will be discussed. Whereever necessary examples of NMS developed by Telesat (called SNS-1000) will be quoted.

Section 2 provides an over view of a BOD network. The alternatives of control communication systems(CCS) which is used for signalling, control and network management purposes are briefly discussed in Section 3. In Section 4, the salient features and functions of customer management system(CMS also refered as Client Terminal) provided at the customer premises and used in conjunction with an earth station are described. In Section 5, the internal architecture of the network management system (NMS also refered as Central Controller) and the associated relational database management system(RDBMS) are discussed. Section 6 describes elements of efficient system design and bandwidth assignment algorithms. In Section 7, examples of network topology and applications which could be supported by BOD network in domestic as well as international environment (e.g. business satellite services offered by INTELSAT and its signatories) are briefly discussed.

BOD System Overview

The bandwidth on demand(BOD) service can be defined as,

"Provision of occasional, additional bandwidths and/or the ability to share and reconfigure available facilities or a combination thereof on a scheduled, request or emergency basis to users having earth stations on their premises or in the neighborhood which operate either in a fully private, quasi-private or shared network environment"

The network providing bandwidth on demand(BOD) service can be divided into two parts; (1) the main communication network providing bearer channel services for a wide variety of applications, and (2) the auxiliary control network (SNS-1000) providing signaling, control and service management functions as shown in Fig. 1. This paper mainly deals with the latter.

The SNS-1000 is a PSTN-based network control and management system used in conjunction with a satellite communication network for the provision of BOD services. The SNS-1000 control system consists of three elements; (1) the customer management system (CMS or Client Terminal), (2) the central network management and control system(NMS or Central Controller-CC) and (3) the control communication system (CCS) which links the former two.

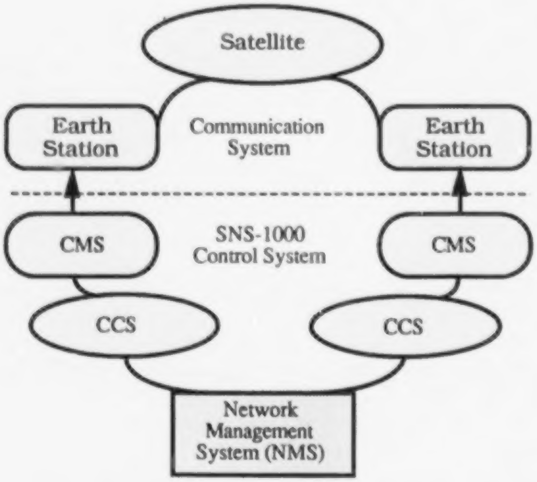


Fig. 1 Schematic of Bandwidth-On-Demand Network

SNS-1000 allows users to access occasional and additional transmission capacity (bandwidth) service on a request basis. The users can also directly reconfigure the network topology as required. The Central Controller is the heart of the network which supports the bandwidth on demand (BOD) service.

Subscribed users will be able to request bandwidth for immediate use or book in advance per desired schedule through a personal computer (MacIntosh) located at the earth station premise or on the user's desk. When necessary, the Central Controller can establish communication links between earth stations located at customer premises.

The CMS terminal allows the user to select any available data rate ranging from 56 kbps to 1544 kpbs. The variable data rate satellite modems available now can support any data rate between 56 to 1544 kbps at the increment of 1 bps. Multi-node users can reconfigure their networks into point-to-point, star, virtual and full mesh topologies when desired. The users could subscribe to access bandwidths from a common pool or from a private pool or both. This flexibility not only meets the needs of small, medium and large sized corporate users at-large but also provides them a smooth and least expensive growth path.

The CMS terminal provides the customer with the options of a wide range bandwidth selection, network topology reconfiguration, simplex, duplex (symmetric & asymmetric) data rates, pay per use, usage tracking, time-zone traffic sharing, gradual growth, etc. By subscribing to the BOD service the customer will not only be in-charge of the satellite communications network and service but also will be able to control the cost and associated savings !

Control Communication System(CCS)

The control communication channel is used for carrying customers **request** to the controller and controller's reponse **(assignment)** reponse to customers.

The alternatives for a control channel are, (i) public switched telephone network(PSTN), (ii) public switched data network(PSDN), and (iii) low speed satellite link. Depending on the type of premise environment the PSTN access can be provided through (1) a direct line, (2) an appropriate PABX, or (3) analog cellular access line.

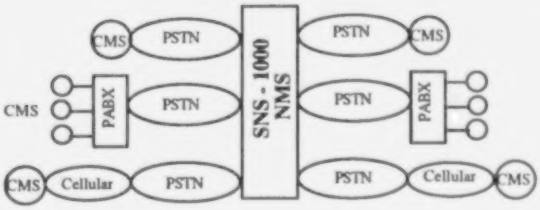


Fig. 2 Control Communication System(CCS) Alternatives

Customer Management System(CMS)

The control system at the customer premise is called customer management system(CMS) or Client Terminal(CT). The CMS is an intelligent, auxiliary network management system which performs five important functions;

(i) service management,
(ii) database management,
(iii) communication management,
(iv) control management, and
(v) monitoring.

The ***service management*** functions include (1) system installation, (2) order entry with a number of options such as bandwidth selection, network reconfiguration, pool selection(public or private) , (3) add and delete users at the customer premise, and (4) provide on-line help and usage information to the client.

The CMS also performs a local ***database management*** function. The CMS maintains local earth station profile, traffic/call profile, local users directory, accessible earth stations directory, and usage record.

The CMS performs a number of ***communication management*** operations. These include establishing, maintaining and terminating communication links of the premise earth station modem in conjunction with the NMS. The CMS translates user entries, formats the transmission packets and handles the communicaiotn protocol with the NMS. As the customer will be directly performing call management functions, it is very important that the CMS has excellent graphic interface and provides clear human-machine communication with very high friendliness and reliability.

The CMS is responsible for ***control management*** of the local earth station. The CMS directly communicates with the local ES modem and activates and deactivates the modem(s) as per the booking schedule authorized by the NMS.

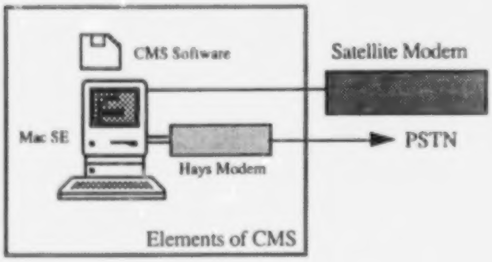


Fig. 3 Components of the Customer Management System (CMS)

The CMS will ***monitor*** and report the local ES status. The status report include the transmission/receive data rates, modem on/off, carrier lock, and overall modem status. At the request of the user, the CMS will readily poll and obtain the local modem status, however, the CMS will not be able to change the modem status or parameters without the necessary authorization of the NMS.

The hardware platform of the CMS consists of a MacIntosh computer with appropriate floppy drives and/or hard disk and a Hayes 2400 baud or compatible in-band voice line modem. The software platforms include appropriate System and Hypercard packages along with a copy of SNS-1000 CMS software. The Mac terminal will be connected to the satellite modem via RS-232 cable in the case of a single modem and via RS-232 to RS-485 converter in the case of multiple modems.

Network Management System(NMS)

The heart of the BOD network is its network management system (NMS) which consists of a main processor, one backup auxiliary processor and voice-band modems. The NMS rack is equipped with monitor(s) and a patch panel.

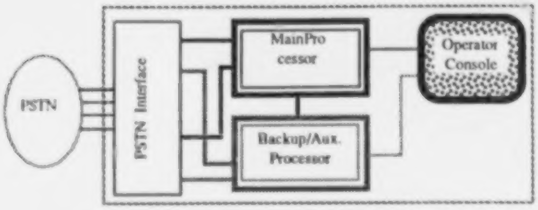


Fig. 4 Schematics of SNS-1000 Network Management System(NMS)

Separate monitor and control keyboard are provided at the operator console.

Database Management System(DBMS)

The key component of the NMS controller is its relational database management system (RDBMS). The records maintained and handled by RDBMS can be classified into two categories; (1) static elements and (2) dynamic elements.

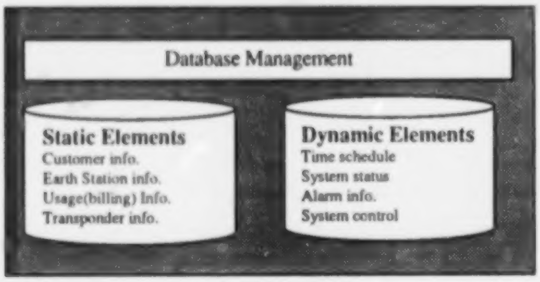


Fig. 5 The RDBMS Resident in NMS Controller

The static(time-invariant) components of the RDBMS include;

Customer information,
Earth Station Information,
Usage (billing) Information, and
Transponder Information

The dynamic (time-variant) components of the RDBMS include;

Time Schedule Management
Algorithm Management, and
Problem Management

Bandwidth Assignment

Maintaining a pool of carriers and assigning them efficiently is very important for successful operation of the BOD service. In the following, the bandwidth utilization and system performance improvement techniques are briefly discussed.

Consider N carriers are designated to support the bandwidth on demand service and the n th carrier is denoted by C_n. The data rate carried by the n th carrier is represented by $r_n^{(k)}$, $k=1,2,\ldots K$ where K is the number of data rates supported. Let the bandwidth required by the n th carrier is denoted by $b_n^{(j)}$, $j=1,2,\ldots J$ where J is the number of distinct bandwidth slots required. The bandwidth occupied by a carrier is related to the data rate by

$$b_n^{(i)} = \beta r_n^{(k)}$$

where β is a factor which depends on the modulation type, forward error correction code rate, guard band, etc.

Pre-Assigned vs BOD

When the traffic is bursty, the BOD system will provide significant cost savings compared to pre-assigned carriers. The BOD system also allows the sharing of the leased carriers with other nodes in the system. Further, when a satellite carrier is leased on a pre-assigned basis, usually the transponder utilization is based on the highest of the power or bandwidth required.

However, when a pool of carriers is designated for BOD service the users can take advantage of the fact that 'the maximum of the sum of two sequences(with non-negative numbers) is always less than or equal to the sum of the maximum of the individual numbers of the sequences'. In the case of BOD, it can be readily shown that,

$$\max\left\{\sum_{n=1}^{N}\frac{p_n^{(i)}}{P}, \sum_{n=1}^{N}\frac{b_n^{(j)}}{B}\right\} \le \sum_{n=1}^{N}\max\left\{\frac{p_n^{(i)}}{P}, \frac{b_n^{(j)}}{B}\right\} \tag{1}$$

where P and B represent the total usable power and bandwidth of a transponder respectively.

Power-Bandwidth Trade-off

While designing a BOD system one can efficiently trade the power and bandwidth utilization to minimize the overall space segment required.

Consider that the total fractional transponder RF power required for accommodating N carriers is given by

$$P_N = \frac{1}{P}\sum_{n=1}^{N} p_n^{(i)} \tag{2}$$

and the total fractional transdponder RF bandwidth required for accommodating N carriers is given by

$$B_N = \frac{1}{B}\sum_{n=1}^{N} b_n^{(j)} \tag{3}$$

The current earth station technology provides the designer with multiple degrees of freedom (modulation type, FEC code rate, G/T, etc.) and one can use unconventional techniques to minimize the overall space segment utilization.

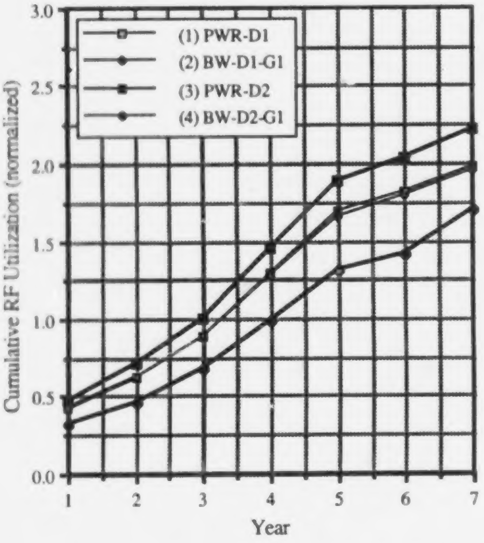


Fig. 6 Power-Bandwidth Trade-off

In Fig. 6, equations (2) & (3) are plotted for different N values. Note that N is represented along X-axis for a hypothetical forecast for a 7 year period. It can be seen from curves (1) & (2) that the total power required is very high compared to the bandwidth throughout the forecast period. By deliberately increasing the bandwidth utilization of certain carriers one can bring down the overall power utilization of the pool. This can be seen in curves (3) and (4) of Fig. 6.

Bandwidth Pooling and Blocking

A further reduction either in number of channels or in the blocking probability can be achieved by partially homogenizing and pooling the bandwidth slots. Fig. 7 shows a hypothetical forecast of channels required for a 7 year period. Let us consider three cases of bandwidth pooling, (1) carriers from 64 kbps to 384 kbps are assigned one type of bandwidth slot, (2) carriers of 64 & 128 kbps are assigned one type of bandwidth slot, and those of 256 & 384 kbps are assigned another type of bandwidth slot, and (3) no bandwidth slot pooling.

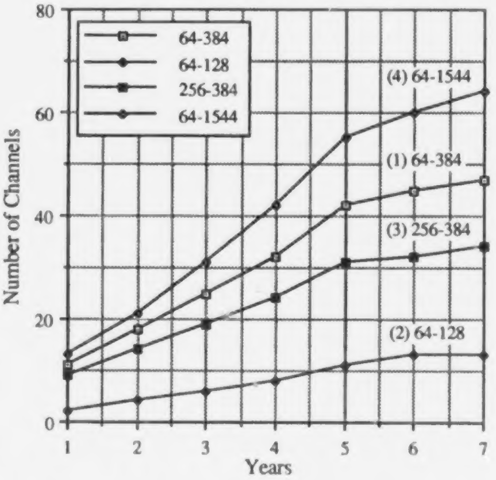


Fig. 7 Bandwidth Pooling

Partial bandwidth pooling is analogous to multiple server queues which normally gives better blocking probability (or lower number of servers for same blocking probability) as compared to multiple single server queues.

The curves 2, 3, and 4 of Fig. 8 show the bandwidth required for the three cases of bandwidth pooling. In all three cases the total number of carriers are the same. However, the blocking probability has been found to decrease significantly for a moderate increase in the bandwidth required.

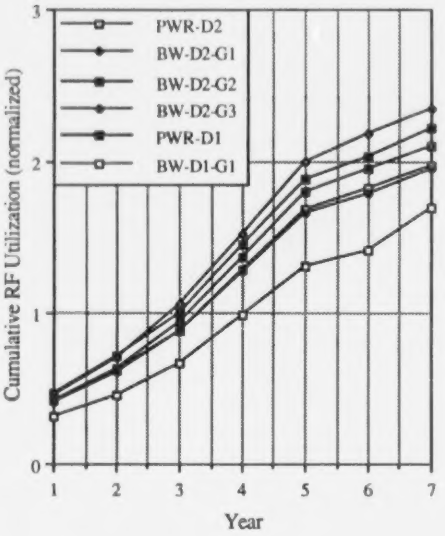


Fig. 8 Bandwidth Pooling vs Blocking

Alternatively, the partial bandwidth pooling will help reduce the number of required channels when the desired blocking probability is kept constant for a given traffic.

Networking and Applications

Network Configuration

The BOD users will be able to configure their network to one of the topologies illustrated in Fig. 9.

Applications

The BOD software and associated channel assignment algorithm are designed to support a number of applications. These include;

Videoconferencing : Full duplex, compressed video and audio conferencing is usually done at data rates ranging from 128 to 768 kbps. Depending on the BOD network software and the video codec used, conferencing calls can be setup in (1) Point-to-point, (2) Point-to-point with multiple listeners, (3) Multi-node modes. It is also possible that there may be asymmetry between transmit and receive data rates. An example of a videoconferencing network using BOD is shown in Fig. 10. This network consists of three client sites viz., Ottawa, Toronto and Calgary and one Central Controller(at Allan Park) performing network management and control functions. Anikom BOD is a trade mark of Telesat's BOD service offering.

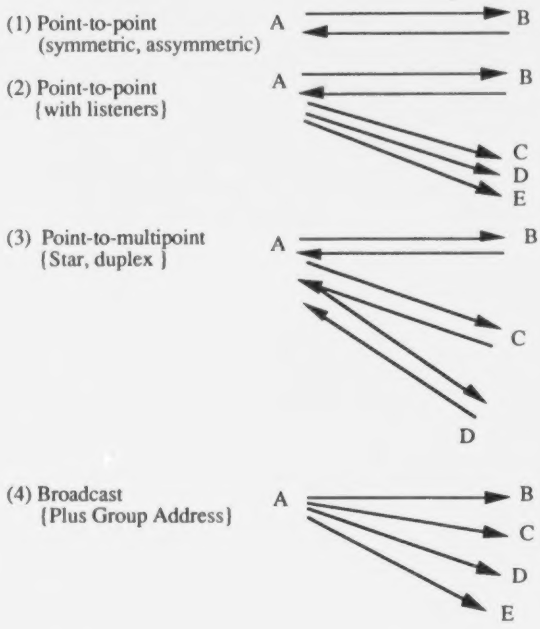


Fig. 9 Possible BOD Network Topology

Additional Bandwidth On Demand (ABOD) : Users already using a pre-assigned(PA) link (say 56 kbps) may occasionally need an additional bandwidth (say 384 kbps). The occasional use bandwidth may be provided either (1) through a separate satellite modem, (2) through the modem used for the PA service via a multiplexor. In the later case the data sync and integrity of the fixed service are important. All network topologies and bandwidth combinations discussed above are possible.

Disaster Recovery (DR) : This is a high priority low probability service. Usually a separate pool of channels is reserved for the service. All data rates and topologies are possible, although point-to-point is the most common configuration.

Fig. 11 illustrates a disaster recovery network with site diversity backup. Note customers using a satellite link for regular communications need can reconfigure the network and use the same carrier to serve the backup site in the event of disaster.

Virtual Mesh : Earth stations having multiple modems can establish full mesh connections to support video and image conferencing applications. It is also possible earth stations having one or two modems may establish virtual mesh connections in a round robin fashion (see Fig. 12).

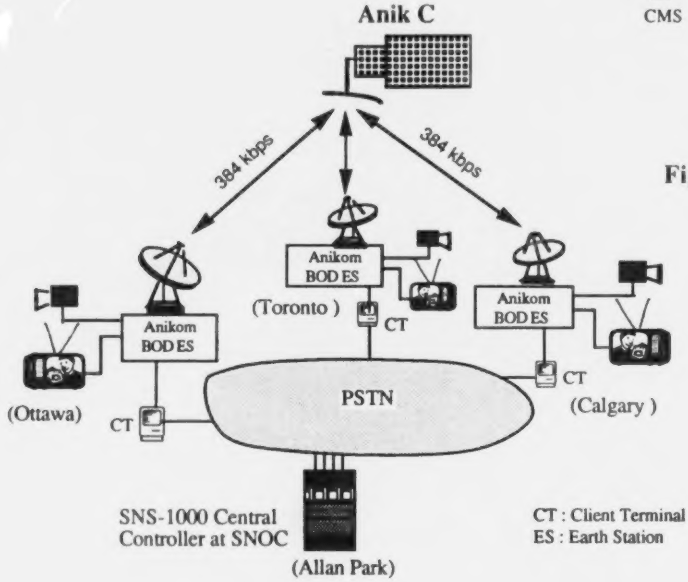
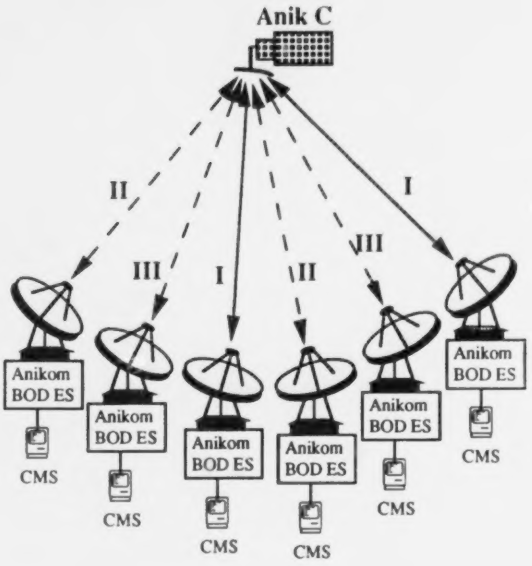

Anik C
384 kbps
384 kbps
Anikom BOD ES
(Toronto)
CT
Anikom BOD ES
Anikom BOD ES
(Ottawa)
CT
PSTN
CT
(Calgary)
SNS-1000 Central Controller at SNOC
(Allan Park)
CT : Client Terminal
ES : Earth Station

Fig. 10 Typical BOD Network Supporting Videoconferencing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Anikom BOD ES
CMS
Anikom BOD ES
CMS

Fig. 12 Virtual Mesh Circuit Sharing

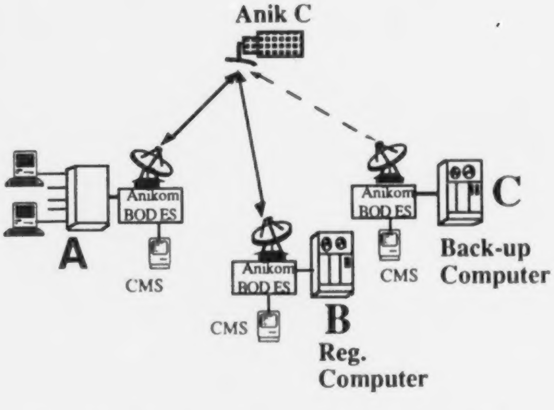
Anik C
Anikom BOD ES
A
CMS
Anikom BOD ES
CMS
B
Reg. Computer
Anikom BOD ES
CMS
C
Back-up Computer

Fig. 11 Disaster Recovery-Site Diversity Backup

MANAGEMENT OF LARGE-SCALE NETWORK

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ABSTRACT

A large-scale network is a network in a large area with advanced and complicated functions. Therefore, to control the operation of the large-scale network, fault cotrol and configuration control should be considered.
This paper describes the effects of resolving problems by the network centralized monitoring system.

1. NETWORK CENTRALIZED MONITORING SYSTEM

Network managemnt applications are divided into two types: operation and maintenance. We think, which is the basic concept to construct the network centralized monitoring system by a few operators. Maintenance is performed together with carriers and communication instrument manufacturers according to the mainteance contract.
For operation, professional network system operators engaged in all the control applications.
Those above make it possible to focus a fault window, to control the maintenance system over the country, and to grasp accurate fault infomation. Then, the operation of the large-scale network system can be controlled by a few operaters. Network control by operation and maintenance is for systemizing network control applications. Many problems still remain in the current network management system. We are, however, thinking of controlling the operation of the large-scale network system with maintaining the centralized monitoring system. Chapters herein after explain the current problems and the future network management applications.

2. CURRENT OPERATION CONTROL OF NETWORK

To take quick actions to faults, to change network configuration, and to optimize the system, network operators perform their assignments as follows.

2.1 FAULTS MANAGEMENT

Quick action: Communication equipment is monitored by the macro monitoring system and remote monitoring systems. This causes time shortage of founding and informing faults. Then, quick action can be taken to the faults.
Preventive maintenance: Physical status of a line is grasped by the remote monitoring system in modem. preventive maintenance for a line fault is possible by grasping the status of the line which uses the statistic information function of a remote monitoring system of a packet switching device.

2.2 CONFIGURATION MANAGEMENT

Network configuration is controlled only by the center centralized control.
For communication instrument and lines installed all over the country, their change histories controlled by creating a control ledger for each of hardware, and lines. Based on the ledgers, the network is changed and materials necessary for fault-shooting are created.
The center changes data by the remote monitoring system according to the change of network configuration such as additional terminal installation.

2.3 SERCURITY MANAGEMENT

The network is prevented from illegal access by specifying terminal connection by the functions of the packet switching device.
The center changes the connection apecification and specifiles the connection of new terminals by the remote monitoring system.

2.4 PERFORMANCE MANAGEMENT

For performance management information is collected as for the following items.
- Line use rate
- CPU use rate of the packet switching device
- Buffer use rate of the packet switching device

3. FUTURE NETWORK OPERATION CONTROL METHOD AND PROBLEMS

The network continuously changes due to internal and external elements. Internal elements are represented by a company's systematic strategies. External elements are represented by new communication services such as ISDN provided by telecommunication companies and new products provided by manufacturers. These elements also cause the change of the network system. Corresponding to the variable network, it is necessary to serve it in a low price without reducing efficiency to a minimum. To realize the network with the best efficiency and maintain it, it is much more important to establish the network control method below.

3.1 MANAGEMENT ORGANIZATION

For the operation control of the network, it is necessary to clarify the assignments of a network operator and a network maintenance person and to develop their assignments.

3.2 CONFIGURATION MANAGEMENT INFORMATION CONTROLLED DATABASE

Configuration management information and faults management information of communication instrument lines are related to each other. They need be controlled only by database and used effectively.

3.3 DEVELOPING FUNCTIONS OF THE MONITORING SYSTEM

For the future network management system, it is necessary to develop its functions as for the following items.

- -Automatic parameter change
- -Fault isolation tool with AI
- -Integrated network management system

3.4 ADOPTION OF A STANDARDIZED COMMON MANAGEMENT PROTOCOL TO CORRESPOND WITH MULTIPLE VENDORS

If the network management system is integrated furthermore and used by much more vendors, connection between different instrument is need.
In addition, more than one communication service providers are also needed.
To control lines between multiple systems, it is essential to develop the product adopting a standardized common management protocol.

4. CONCLUSION

Operation of the large-scale network have been controlled using the network centralized monitoring system. Each of the control application in the network is an independent function at present.
The operation of the large-scale network, however, should be controlled by connecting the control applications.
Larger the network becomes, the network control applications must be systemized.
We consider that the network control develops by systemizing the network management applications.

REFERENCES

1) Makoto KAWASHIMA, "CABIN NETWORK SYSTEM," FUJITSU Journal, Vol.13, No.7, 1987.

2) Makoto KAWASHIMA, et al., "NETWORK MANAGEMENT OF LARGE-SCALE NETWORKS," PTC'90, 1990.

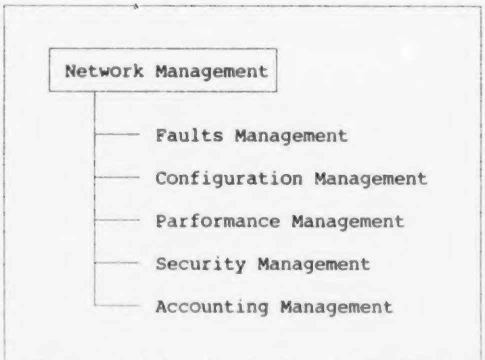


Figure 1 Network management function

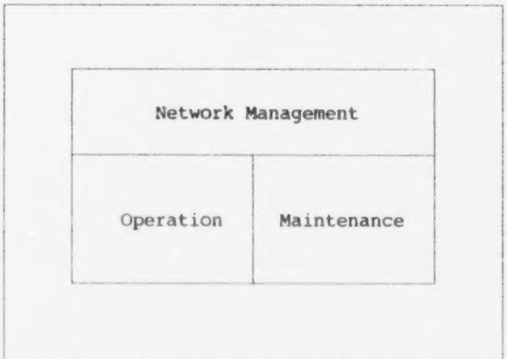
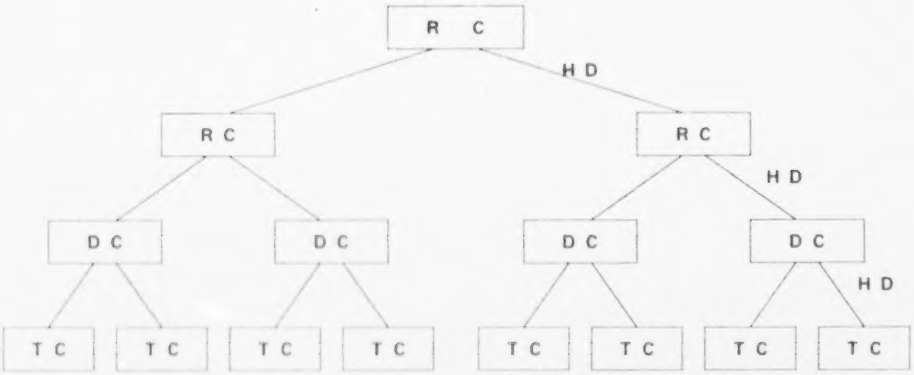
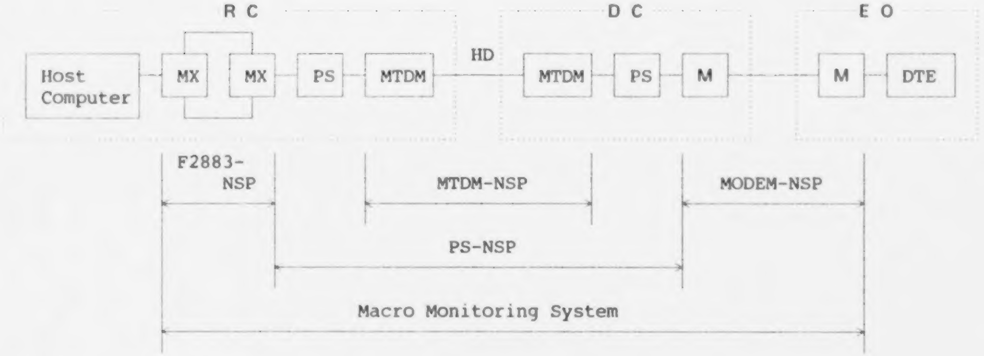


Figure 2 Divide of network management


R C
H D
R C
R C
H D
D C
D C
D C
D C
H D
T C
T C
T C
T C
T C
T C
T C
T C

R C : Regional Center
D C : District Center
T C : Toll Center
H D : High-speed Digital line

figure 3 Office rank


R C
D C
E O
Host Computer
MX
MX
PS
MTDM
HD
MTDM
PS
M
M
DTE
F2883-NSP
MTDM-NSP
MODEM-NSP
PS-NSP
Macro Monitoring System

HD: High-speed Digital line
MTDM: Multi-media Time Division Multiplexer
PS: Packet Switching device
MX: Multi-pleXer node
M: Modem
NSP: Network Survice Processor
EO: End Office

figure 4 Configuration and scope of monitoring for centralized monitoring system

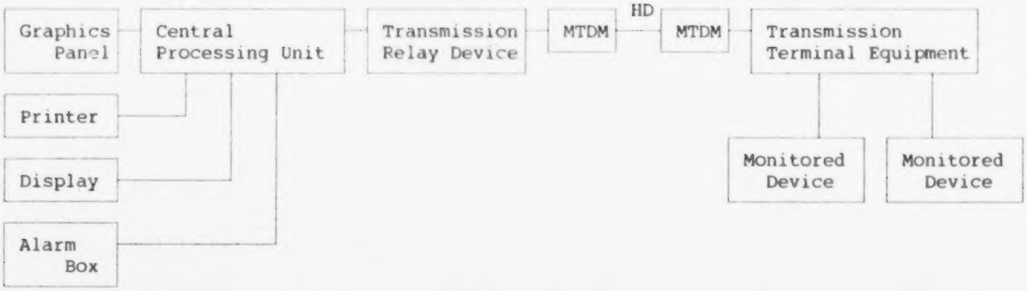

Graphics Panel
Central Processing Unit
Transmission Relay Device
MTDM
HD
MTDM
Transmission Terminal Equipment
Printer
Display
Alarm Box
Monitored Device
Monitored Device

figure 5 Configuration of macro monitoring system

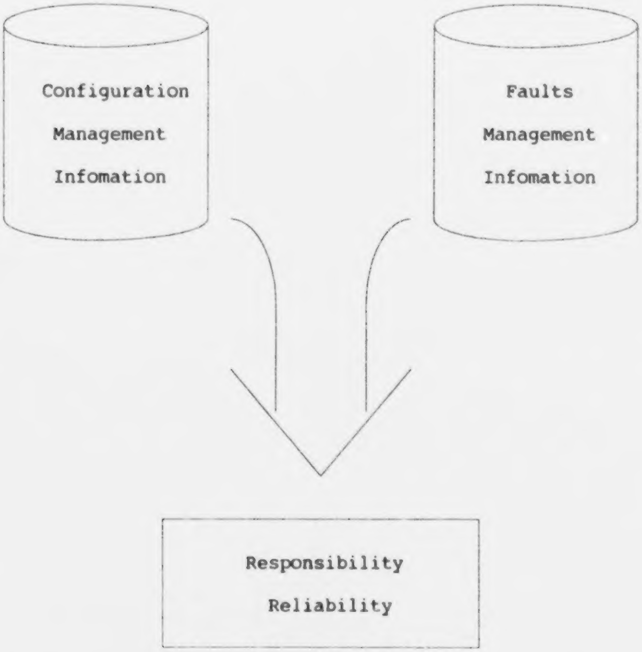

Configuration Management Infomation
Faults Management Infomation
Responsibility Reliability

figure 6 Configuration and faults management infomation contorolled by DATABASE

NETWORK MANAGEMENT SYSTEM OPERATIONS FOR THE PUBLIC SWITCHED TELEPHONE NETWORK IN THE NORTHEAST UNITED STATES

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1. ABSTRACT

The operations in the Network Management System of the telephone operating companies of the NYNEX Corporation is described. These telephone companies provide service to 15 million lines in the Northeast United States. Surveillance and control of this large network is accomplished through the work of highly-trained personnel who utilize integrated computer systems and procedures developed over more than twenty years.

2. INTRODUCTION

Today the need for sophisticated network management, i.e., surveillance and control of the network, is recognized as a crucial element in telecommunications, particularly as networks expand the range and complexity of their services to both business and residence customers. In order to maintain high levels of customer satisfaction with its services, while improving revenues and lowering costs, a modern telecommunications administration must take advantage of the capabilities inherent in modern Network Management Systems (NMS). Such systems are a synthesis of people, procedures and automated tools which are carefully planned and designed to boost the call completion rate despite congestion, detect network anomalies and isolate faults, and improve the planning of network expansion and modernization. Redundancies built into all aspects of the system allow the telecommunications provider to continue to monitor and control the network under both normal and abnormal conditions.

This paper provides a general description of operations in the Network Management System of the NYNEX Corporation. NYNEX has planned, engineered, installed and operated a complex Public Switched Telephone Network (PSTN) covering six states in the Northeast United States. This region has a tele-density of over 80 telephones per 100 people and contains 12 percent of the U.S. population. Our property, plant and equipment assets are valued at more that US $25 billion. The two NYNEX operating telephone companies, New York Telephone and New England Telephone, provide service to over 11 million customers with nearly 15 million access lines. These customers include one quarter of the world's largest banks (including 450 foreign banks), the three major U.S. television networks, and 15 percent of the country's data processing centers. Our network also serves large suburban and rural areas. The call volume generated by this customer base, over 171 million calls per business day, requires the highest levels of network management capabilities.

NYNEX has been a leader in surveillance and control of the public switched network for many years. New York Telephone, the largest NYNEX subsidiary, was the first Bell System operating company to establish and operate a network management system, beginning in 1968. Over the years, we have been a leader in developing network management systems, procedures and practices, and, as such, we are a major contributor to Bell Communications Research (Bellcore) standards development in this field. NYNEX procedures and systems are an amalgam of state-of-the-art computer equipment and procedures under the control of highly-trained personnel.

Each of the two NYNEX telephone companies has its own Network Management Center (the heart of the NMS) providing surveillance and control of the inter-nodal network, while an array of sub-centers (reporting to the NMC) handle surveillance and control of switching units and provisioning and maintenance of service. The entire network is integrated so that information and control flows between centers and systems with little or no human intervention. Valuable personnel time is reserved for general oversight and manual override of automated controls when unusual or preplanned activities (such as holidays and special events) warrant it.

3. NYNEX NETWORK MANAGEMENT SYSTEM OPERATIONS

NYNEX network management system operations range over a large territory in the Northeast United States, serving a variety of customers in rural areas and suburbs, as well as the metropolitan regions of New York City and Boston. The two NYNEX telephone operating companies, taken individually, are each among the largest telecommunications networks in the world. The map in Fig.1 is illustrative of the size of the network covered by NYNEX.

NYNEX NETWORK TERRITORY IN THE UNITED STATES

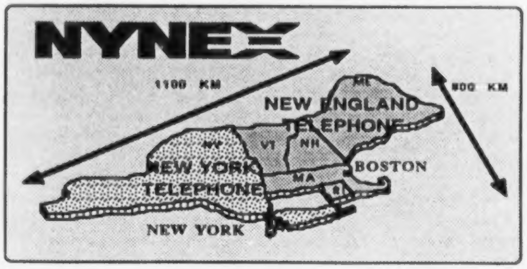

Fig. 1

The Network Management Center (NMC) is the focal point of any network management system and is the front line of support for the continued operation of the network. NYNEX Network Management Systems operations are based on three factors:

- **PEOPLE** who are directly responsible for the operation and maintenance of the network;
- **TOOLS and FACILITIES** used by the operations staff to monitor and maintain the network (including preventive maintenance and fault location and resolution);
- **OPERATIONAL PROCEDURES** that have been established and tested over time to ensure organized and efficient operation of the network.

The architecture, functions and capabilities of the NMS are critical factors in effective network management. A successful design requires a judicious balance between performance and cost. Not all data that can be extracted from the network nodes and links is useful or necessary for effective network management. Hence the cost of collecting, analyzing and acting on certain data may be unacceptably costly when compared to the incremental service improvement that can be derived from such data.

The most critical aspect of effective management of the network is the people who run the NMS and the organization of those people. At NYNEX, we carefully match qualified people with appropriate job assignments, we make sure they are properly trained, and we pay very close attention to organizational relationships.

The NMC in each of the two NYNEX operating telephone companies is a centrally located operation consisting of computers, display systems and personnel. For simplicity, the following discussion will describe only the NMC for New York Telephone (a company which alone handles over 100 million calls per business day). The NMC for New England Telephone is structured and operated in a similar manner.

The New York Telephone NMC manages a network consisting of nearly 9 million access lines, over 700 switching locations, and over 830,000 trunk (bearer) circuits spread across the State of New York and a small part of Connecticut. The current functions and responsibilities of this center were developed over the past 22 years. (Originally, many of its functions were performed manually at each switching center.) A completely redundant center located at a remote location can be quickly activated to perform all of the functions of the main center, if an abnormal situation develops as a result of, for example, a natural disaster or a national emergency.

The New York NMC is organized into six groups in the control room of its New York City location. These are described below.

NSC (Network Service Center) Group is responsible for that part of the surveillance function which detects terminating and originating failures at switching nodes and then signals switching units to take appropriate action to avoid congestion. The computerized system that performs this function and alerts the operators to the status of the network also detects when originating and terminating failures have been cleared. Again, the system signals switching nodes to restore the normal network configuration.

NMC (Network Management Center) Group performs the task of surveillance over the trunk (bearer) network. This group is involved in coordinating alternate routing and carrier restoration efforts.

SEAC (Signaling Engineering and Administration Center) is responsible for the Common Channel Signaling (SS #7) network as it is put in service.

SPOC (Single-Point-of-Contact Center) receives calls from certain large business customers who subscribe to certain specialized or complex services (such as high-speed digital facilities). This operation provides these customers with a convenient, centralized interface to the telephone company.

NSEP (National Security Emergency Preparedness) group is involved with national and local government organizations in providing specialized services and in maintaining vital services.

Corporate Communications Desk receives calls from throughout the company on all unusual activity, such as accidents and vandalism, and issues reports to appropriate higher management.

The New York NMC performs the monitoring, analysis and control functions, aided by computer systems, display boards and terminals which receive, process and present a vast amount of information from the switching nodes and internodal facilities. This information, when analyzed by time-tested algorithms, gives the operators a near real-time picture of the network.

The computer systems utilized by the New York NMC are depicted in Fig. 2 below. Of the over 100 million calls processed by the New York Telephone network, about 90 million are surveilled by five "merging" computers (originally developed at New York Telephone) on a near real-time basis. Both originating and terminating failure indications are portrayed within a five-minute moving window. In addition, each of the five computers issue reports which document the analysis of each 24-hour period's failures. Repeated individual equipment failures and trouble patterns in trunk facilities (conventional, microwave, and fiber optic) and in the switches (Step-by-Step, Crossbar, electronic analog and digital) are revealed. Many of the reports also portray historical and statistical data over a 16-day period.

The merging computers also receive 65,000 daily reports from the Multi-Link Irregularities

Processor. This processor receives reports from other network sources, such as toll operators, digital transmission links, repair service bureaus, and a mechanized call-completion analysis system developed by New York Telephone known as CCAS (Call Completion Analysis System). CCAS launches test calls throughout the network to detect call completion problems.

On an average day, the merging computers report 350,000 call anomalies to the Message Switch Computer, which, in turn, issues 75 real-time alerts and prepares 5,000 24-hour comprehensive reports to the NMC staff (or to appropriate local control centers known as Switching Control Centers, which are described below).

NYNEX NETWORK MANAGEMENT CENTER

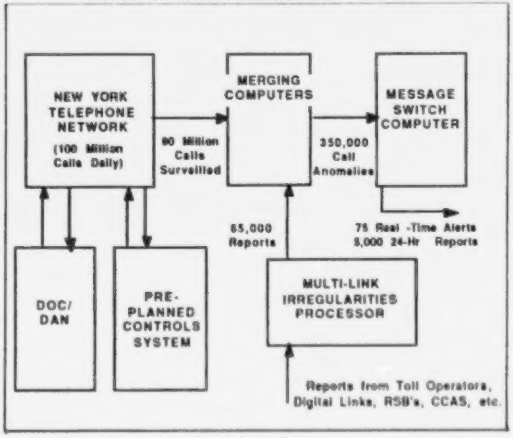
NEW YORK TELEPHONE NETWORK
(100 Million Calls Daily)
90 Million Calls Surveilled
MERGING COMPUTERS
350,000 Call Anomalies
MESSAGE SWITCH COMPUTER
75 Real -Time Alerts
5,000 24-Hr Reports
65,000 Reports
DOC/ DAN
PRE-PLANNED CONTROLS SYSTEM
MULTI-LINK IRREGULARITIES PROCESSOR
Reports from Toll Operators, Digital Links, RSB's, CCAS, etc.

Fig. 2

Another data acquisition system monitors for changing traffic loads or network faults and allows for manual implementation of "preplanned" controls. Such controls are implemented, for example, on holidays when calling patterns have been historically shown to vary from the norm, or for special customer networks which exhibit unusual traffic patterns on a cyclical basis due to their own business patterns. Still another automated system, DOC/DAN, acquires data directly from the switching nodes and dynamically reconfigures the network, as required.

At the center of all of this activity are the human analyzers. The terminals and display boards in the NMC present the network status to this personnel. The analyzers also receive calls from field personnel seeking assistance in resolving problems. The work of the analyzers includes communicating with nearly all organizations in the telephone company, e.g., engineering and switching administration. When it is deemed necessary, analyzers can issue reports to upper management to facilitate problem resolution.

NMC analyzers are the central points of contact in the hierarchy of local control, provisioning and maintenance centers. At New York Telephone, a network of SCC's (Switching Control Centers), each monitoring about 50 switching units, interfaces with NMC analyzers. In addition, analyzers deal with SSC's (Special Service Centers) which perform provisioning and maintenance functions (including remote testing) for private line circuits, and ARSB's (Automated Repair Service Bureaus). NMC analyzers also interface with inter-exchange carriers which provide long-distance telecommunications services in the United States and overseas. (See Fig. 3 below.)

NYNEX ANALYZER INTERACTIONS

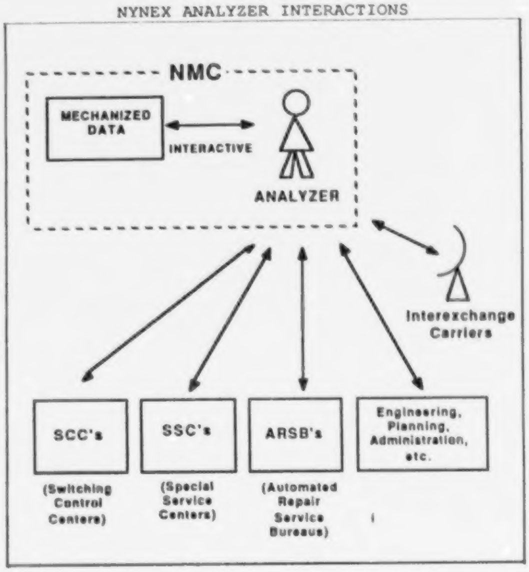
NMC
MECHANIZED DATA
INTERACTIVE
ANALYZER
Interexchange Carriers
SCC's
(Switching Control Centers)
SSC's
(Special Service Centers)
ARSB's
(Automated Repair Service Bureaus)
Engineering, Planning, Administration, etc.

Fig. 3

The most complex activities performed by the NMC analyzers involves the analysis of the vast array of data at their disposal to identify statistical anomalies which could point toward possible latent network problems as well as incipient decay in network components. The following types of failures are examples of those monitored and cross-referenced by the analyzers:

- Partial Dials - insufficient digits received by switches to complete calls;
- Stuck Senders - numbers received by switches can not be translated into call routes;
- Time Outs - switch does not receive adequate digits within its preset holding time.

While any of the above phenomena can be (and often are) the result of customer activity, statistically significant numbers of them traced to particular trunk groups or switches may indicate incipient decay of the cables or other equipment involved in those trunk groups or switches. By analyzing the proportions of the various types of such failures, the analyzers are able to identify the most likely causes of such failures and initiate action to correct the problem before network failure results.

Examples of this type of problem are:

- Insulation break-down in cables, splice cases, etc.;
- Erratic behavior by carrier equipment;
- Spurious signals reaching or generated in a switch;
- Network capacity nearing exhaust in some sectors.

At the same time, different profiles developed by the analyzers may indicate that customer activity is indeed the cause. The NMC analyzers can suggest steps to be taken to reduce problems such as:

- Inaccurately or inadequately advertised telephone numbers;
- Non-standard Customer Premise Equipment (CPE) attached to the network;
- Changing demographics (which cause calling patterns to change over time);
- Insufficient number of lines to a customer's location for that customer's potential traffic (which provides a sales opportunity to the telephone company);
- Inordinately high calling rates to a single number, group of numbers or area.

The last item is generally temporary in nature, caused by unusual events such as a natural disasters or promotions (e.g., "call-in" contests), and is not necessarily predictable. In order to keep congestion from incapacitating the network as a result of these events, the NMC personnel have powerful network control tools available to them. For example, the NMC can apply "call gapping." This means that, through commands to their computers, the NMC personnel can instruct the appropriate network nodes (where the traffic is originating from) to allow only a designated percentage of the calls to be completed to the heavily called number, group of numbers or area. Call gapping can be applied immediately after the analyzers recognize the problem. Call gapping can also be applied in a preplanned manner. Such a situation can occur when, for example, a radio station decides to run a "call-in" contest and, as required by the regulatory bodies, they inform NYNEX, in advance, that they will run such an event at a given date and time. The NMC can program the computers to automatically begin call gapping for the designated contest telephone number at a specific time just before the contest starts. The analyzers will then closely monitor the network status as the event unfolds. If necessary during the event, they can change the automatic call gapping parameters to either allow more or less traffic to complete, as required. Call gapping can be combined with the assignment of special telephone numbers to the contest promoters for them to publicize. These special telephone numbers route the traffic to the "choked" network--a set of trunks within the existing network designated for such special events. Our experience in the New York City metropolitan area has shown that this is an effective solution to network congestion problems of this nature.

The work of the NMC personnel and facilities can be summarized in these terms:

- Identification of network problems;
- Analysis of network problems;
- Network Management to minimize congestion in the network;
- "Close out" to assure that the various field and engineering groups clear network faults on a timely basis;
- Follow-up to detect repetitive faults and inadequacies in network facilities and to work with planning and engineering organizations to eliminate such conditions.

4. CONCLUSION

Network Management System operations in today's PSTN environment is increasingly becoming a critical component of total operations for telephone administrations. It is not enough to simply provide surveillance over the network; the conjunction of surveillance with control of the network in a central location has been shown by experience to produce the most optimal network performance. The surveillance function has the dual role of aiding in the correction of latent network problems *and* helping to prevent future problems (such as those caused by changes in calling patterns and the introduction of new services). The control function has the role of coping with network problems and crises in real time. Both of these functions, when carried out utilizing modern computer systems and trained personnel overseeing the entire operation, yield significant results in improved operations and improved quality of service, while helping to boost revenues for the telephone administration.

5. ACKNOWLEDGEMENT

The author wishes to express his thanks to Glenn O. Myers, senior consultant to NYNEX International Company, for his valuable assistance in preparing this paper.

MONITORING SATELLITE COMMUNICATIONS SYSTEMS —WHY AND HOW

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1. ABSTRACT

To effectively manage a satellite communications network it is necessary to monitor the various communications carriers within that network. Satellite resource providers must be aware of the carrier power, center frequency, and bandwidth of each carrier to maximize the throughput of a given satellite transponder. Of equal importance, the space segment provider must ensure that customers or users are receiving their fair share of the satellite resource. Satellite carrier monitoring systems can provide these capabilities.

2. INTRODUCTION

This paper presents an overview of satellite monitoring systems (SMS). This includes a brief description of the system procured by COMSAT World Systems Division (WSD) for use with Atlantic Ocean and Pacific Ocean Region INTELSAT satellites. A general description and background of satellite monitoring systems is presented, followed by typical network architectures, general software features, SMS operational considerations and desirable additional monitoring features.

3. BACKGROUND

The first known satellite carrier monitoring system was developed by COMSAT and put into operation at the Andover, Maine, TT&C facility in May 1970 (1). It was used to monitor the carrier power levels on the INTELSAT III satellites. The basic system was composed of a power meter, RF filters, RF switches, and a noise source. Carrier power was measured by filtering the output of the LNA to extract the appropriate carrier and measuring the carrier power with the power meter. The system was calibrated by injecting a noise signal of a known level at the input of the LNA and measuring the signal levels at the output of the LNA. This system could not measure carrier bandwidth or center frequency.

In the early 70s COMSAT's satellite carrier monitoring system was refined, and four systems were built and fielded to monitor INTELSAT IV satellites. Further improvement to the monitoring system occurred in the late 70s and ultimately became INTELSAT's communications system monitor (CSM) used to monitor the INTELSAT V series of satellites. This system is still in operation today.

A refinement of COMSAT's original carrier measurement system was developed for the SBS TDMA satellite system in the early 80s (2). INTELSAT procured a similar system from COMSAT to monitor their 120 Mbit/s TDMA network. These systems measured the power of the individual TDMA bursts. A small pilot carrier was injected into the frequency guard bands on either side of the TDMA burst. This carrier was measured in the presence and absence of the TDMA burst. The difference between the two measured pilot carrier's powers is called the small carrier suppression and is a sensistive indicator of the operating point of the satellite TWT. This small carrier suppression was used to compute the satellite TWT operating point. The TWT operating point was then used to compute the TDMA burst power. The burst timing signals were used to gate the measurements on the pilot carrier and to determine the identity of the TDMA burst.

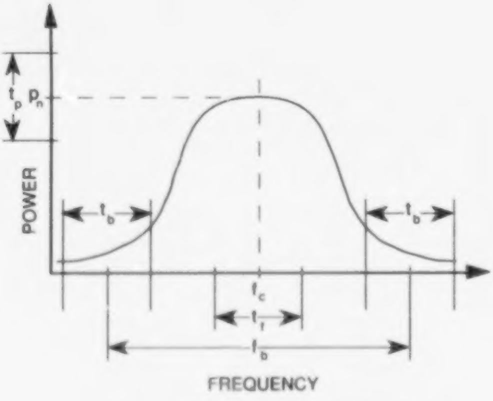
During the early 80s Amalgamated Wireless Pty. Ltd. and Miller Communications independently developed monitoring systems which incorporated spectrum analyzers and a control computer (3), (4), (5). The spectrum analyzers were located at the monitoring sites and controlled remotely by a computer typically located at the satellite system network control center (NCC). The spectral information and control signaling was transmitted over satellite orderwire channels or terrestrially over dial-up lines. This system could measure carrier power, bandwidth, and center frequency.

During the mid 80s, INTELSAT procured a spectrum analyzer-based system similar to the ones developed by Miller and Amalgamated Wireless. This system, known as the Remote Spectrum Analyzer Network (RSAN), augments the existing CSM system and is currently used to monitor all of the INTELSAT satellites located in the Atlantic, Pacific, and Indian Ocean Regions.

4. PURPOSE

Satellite monitoring systems (SMS) provide the satellite resource provider with a wealth of operational information. This information assists in troubleshooting, satellite system operation, fault detection, billing, and transponder power determination among others. The primary purpose of the SMS is fault detection.

Given a set of carriers on a particular transponder, each is assigned a center frequency of operation, an allocated bandwidth, and a certain amount of transponder power. Each carrier must operate within a given tolerance window on any of these parameters. If this tolerance is exceeded, communications can be degraded on that carrier and disrupted on some or all of the other carriers sharing the transponder or even carriers in other transponders. Figure 1 is an illustration of a typical carrier with the tolerances for power, bandwidth, and center frequency defined.



ACCEPTABLE RANGES OF FLUCTUATION

POWER: $p_n \pm t_p/2$

BANDWIDTH: $f_b \pm t_b$

CENTER FREQUENCY: $f_c \pm t_f/2$

Figure 1. Carrier Power, Bandwidth, and Center Frequency Tolerances

The SMS enables the satellite system operator to manually or automatically monitor each carrier's power, center frequency, and/or bandwidth. Should a particular carrier deviate beyond acceptable tolerances for any one of these parameters, the SMS will inform the satellite system operator through an alarm. Depending on the sophistication of the SMS, the operator may extract the operating entity responsible for the alarm, the time/type of the alarm, the link parameters of the alarming carrier, or a spectral plot of the alarming carrier.

5. NETWORK

5.1 MEASUREMENT EQUIPMENT

Satellite monitoring equipment can be grouped into three functional groups. These are the monitoring equipment, calibration equipment, and computer equipment.

The monitoring equipment incorporates either a spectrum analyzer, power meter or both to perform the signal detection function. Spectrum analyzers provide carrier bandwidth, power, and center frequency measurements with limited accuracy. Power meters are inherently more accurate than spectrum analyzers when measuring carrier powers. Unfortunately, power meters are not well suited for measuring bandwidth and center frequencies. A power meter measures the total power of a signal in whatever bandwidth has been established. A spectrum analyzer measures signal power density as a function of frequency in whatever bandwidth is set by its internal filters. The ideal SMS would incorporate both a spectrum analyzer and a power meter. Figure 2 is an illustration of a spectrum analyzer based monitoring site operating in a dual polarization environment. Figure 3 illustrates a power meter-based monitoring site configuration operating in a single polarization environment.

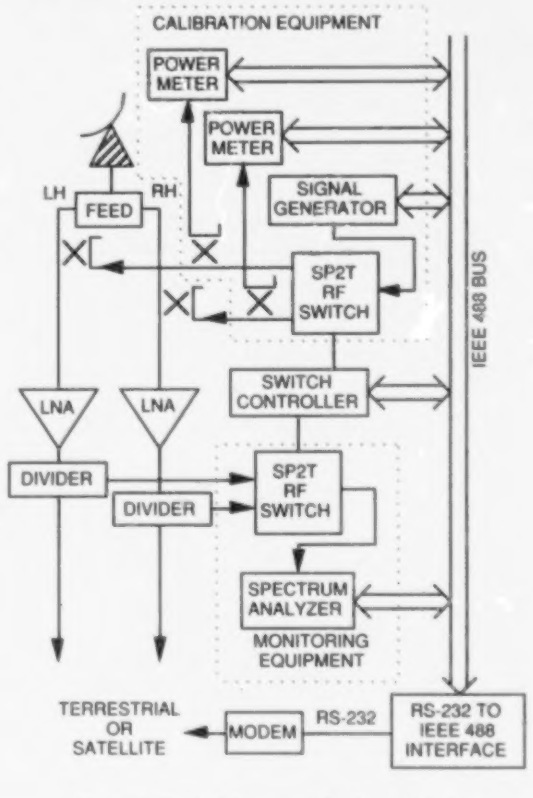


Figure 2. Typical Spectrum Analyzer-Based Monitoring Site Configuration

Significant variations in a particular carrier's power can greatly affect the performance of a satellite transponder

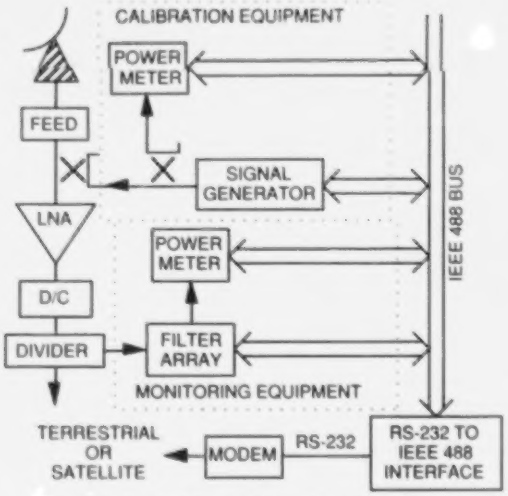

CALIBRATION EQUIPMENT
POWER METER
FEED
SIGNAL GENERATOR
LNA
POWER METER
IEEE 488 BUS
D/C
DIVIDER
FILTER ARRAY
MONITORING EQUIPMENT
TERRESTRIAL OR SATELLITE
MODEM
RS-232
RS-232 TO IEEE 488 INTERFACE

Figure 3. Typical Power Meter-Based Monitoring Site Configuration

and result in degraded communications for all carriers. Therefore it is of great importance to maximize the accuracy of all carrier power measurements. This is accomplished by calibrating the monitoring earth station's receive chain. Calibration equipment is used periodically to determine the gain of the LNA, and the losses in the waveguide, couplers, etc. at the monitoring earth station. The antenna gain can be measured in several ways, but it is usually not practical to make this measurement on a frequently recurring basis. These gains and losses must be accurately known to determine the actual satellite e.i.r.p. The calibration equipment consists of a signal generator, a power meter, and a calibrated directional coupler. The signal generator is used to inject a CW signal of a known power at the input of the LNA. This same signal is then measured using the monitoring equipment connected at the output of the LNA or down converter. The resulting gains and losses are then computed and factored into the calculation of the carrier power and related satellite e.i.r.p. Figures 2 and 3 illustrate the calibration equipment at a spectrum analyzer based and power meter based monitoring site.

Typically, the computer used for SMS network control is either a mini-computer or a high performance personal computer. A multitasking type operating system is preferred due to the typical SMS network configuration and carrier monitoring revisit times to be discussed later. This computer may be incorporated into the measurement device or it may be a stand-alone. Often, the central control computer is a stand-alone device located remotely from the monitoring equipment. Figure 4 illustrates an architecture for the control computer.

5.2 ARCHITECTURE

The basic architecture of an SMS system can take several forms which revolve around the method used to control the monitoring hardware. These architectures can be divided into two general categories: distributed control and centralized control.

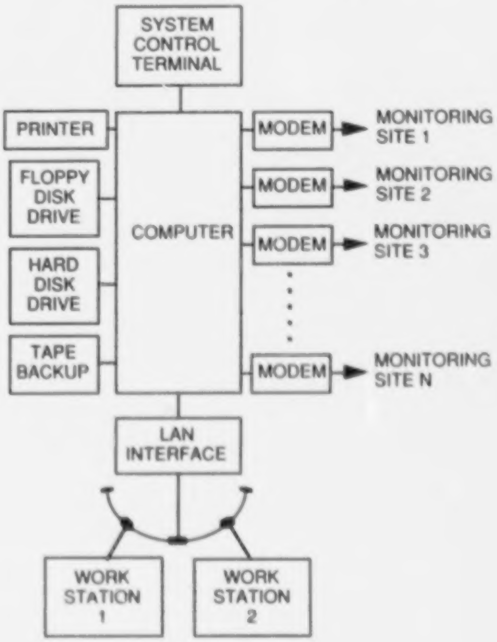

SYSTEM CONTROL TERMINAL
PRINTER
FLOPPY DISK DRIVE
HARD DISK DRIVE
TAPE BACKUP
COMPUTER
MODEM
MODEM
MODEM
MODEM
MONITORING SITE 1
MONITORING SITE 2
MONITORING SITE 3
MONITORING SITE N
LAN INTERFACE
WORK STATION 1
WORK STATION 2

Figure 4. Control Computer Site Configuration

A centralized control architecture is essentially a star architecture with the control computer located at the hub. This architecture is illustrated in Figure 5. The architecture of the associated monitoring sites is illustrated in either Figure 2 or 3. The control site is illustrate in Figure 4. Note that the control site may also contain monitoring equipment. Communications between the control computer and the remote monitoring sites is provided by either terrestrial or satellite links. The main advantage with the centralized control type architecture is that a computer is required at only one site, thereby reducing overall network operational and hardware costs. The disadvantage is that a control computer failure completely disables the entire monitoring network.

In a distributed control architecture, several computers, located throughout the SMS network, may be involved in the control function. There are a number of methods by which control can be arbitrated. On one hand, control can be distributed among all of the monitoring equipment, meaning that each site functions independently and autonomously. The data obtained at each site can be accessed locally or remotely and analyzed using an independent computer. On the other hand, control can be localized at several sites which are assigned control over a subset of the monitoring sites. Information is exchanged between control computers

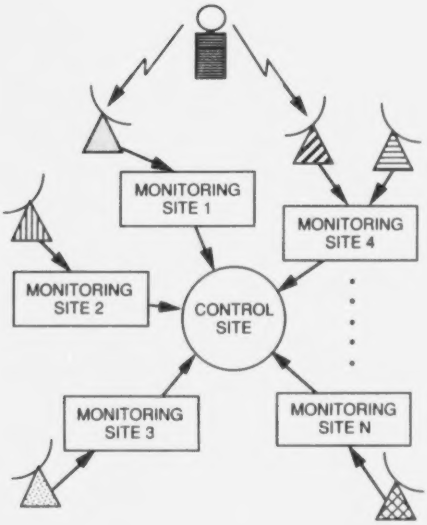


Figure 5. Centralized Processing Architecture

for reduction and analysis over an ETHERNET or similar link. A distributed control architecture is illustrated in Figure 6. The main advantage with this type of architecture is that control is distributed throughout the network. Any single failure will not significantly disable the performance of the network. The disadvantage with this architecture is that the increased amount of computer hardware required results in considerable operational and maintenance costs.

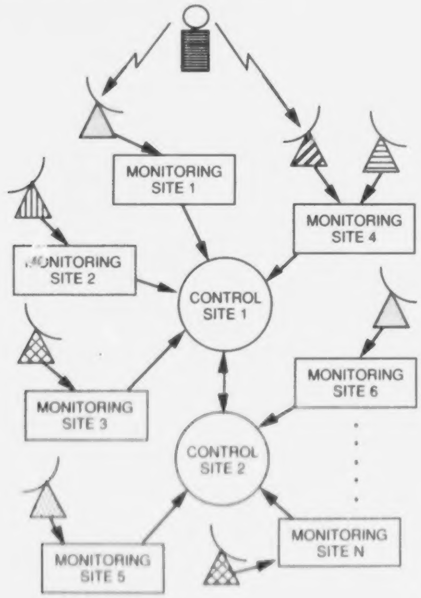


Figure 6. Distributed Processing Architecture

6. SOFTWARE

6.1 SECURITY

Generally, SMS software has a hierarchical structure which is password accessible. The password hierarchy is divided into two main levels, system operator and user. The system operator has control over the system, alarm settings, carrier database, equipment parameters, etc. The user assimilates the data obtained from the monitored carriers to manage the satellite network.

6.2 OPERATING SYSTEM

A multitasking operating system is preferred in a satellite monitoring system environment. Most of the available monitoring systems have either VMS or UNIX type operating systems. Multitasking systems efficiently utilize the monitoring hardware, so that it is controlled concurrently. This means that each monitoring site can monitor its set of assigned carriers in a time period which is independent of the monitoring times of the other sites.

6.3 MODES OF OPERATION

The software used in typical SMS systems provides the user with three general modes of operation. These modes are automatic carrier monitoring, manual carrier monitoring, and instrument remote control. These modes operate concurrently in a multitasking operating environment.

In the automatic carrier monitoring mode, a set of carriers can be continuously monitored automatically. The set of carriers to be monitored is defined in a carrier database which contains the expected power, center frequency, and bandwidth for each carrier. Additional information may include the carrier's origin and destination, data rate if applicable, forward error correction code rate if applicable, etc. The monitoring equipment parameters are also contained in this database so that, as each carrier is measured, the equipment is automatically configured for the carrier to be measured. The SMS normally operates in this mode, continuously monitoring carriers and alerting operating personnel of any alarm conditions.

The manual carrier monitoring mode is similar to the automatic mode in the sense that the same database is accessed for equipment and carrier parameters. The difference lies in the method in which the carriers are monitored. In the manual mode the operator must manually indicate the exact carrier, or group of carriers, to be monitored. Equipment and carrier parameters are extracted from the database. This mode is useful for intensive monitoring of a known carrier which has caused an alarm.

The instrument remote control mode enables the operator to manually configure any monitoring device in the network. This mode does not use any information from the carrier database. The operator must enter all of the equipment and carrier parameters needed to monitor a signal. This mode is used for monitoring spurious signals, or unknown carriers, since their presence cannot be anticipated.

6.4 USER INTERFACE

The user interface varies among the SMS systems available. They range from a command line, or menu system, to a sophisticated X-Windows type graphical interface. The command line interface operates through the manual entry of a series of commands to operate the software and the SMS monitoring equipment. The command line interface is the most difficult to learn and use, but has the advantage that batch command structures are easily implemented. This type of system can easily be tailored by the users to suit their specific needs.

The menu type interface utilizes single keystroke commands to maneuver through various menu screens. These menu screens are arranged in a hierarchical tree structure, providing the operator with control over the SMS network. Generally, the operator must proceed through several menu screens before any system commands can be executed and information retrieved. The menu type interface is somewhere between the command line and graphical interface in terms of ease of use. It is the most restrictive in the sense of being tailorable to the user.

The current state of the art in user interfaces is the graphical interface. This interface has a hierarchical structure as with the menu type interface but rather than using menu screens, graphical screens are used for control. The operator uses the keyboard, a mouse, or track ball to proceed through the graphics screens. The commands and retrieved information are displayed on a single screen unlike the command line and menu interface. The graphical interface is the easiest of all the interfaces to use, and can be tailored to suit the individual user.

7. OPERATIONAL CONSIDERATIONS

When choosing a particular SMS it is necessary to take into consideration a number of operationally related issues. The major issues are the location, loading, and number of satellites monitored; the revisit time; and the measurement accuracy.

7.1 SATELLITES

The purpose of the SMS is to monitor satellite carrier parameters. Naturally this is the most important operational consideration. Ideally, monitoring site locations should be selected to maximize satellite visibility while minimizing the number of monitoring sites. In global beam (typically C-band, L-band) satellite operation the number of monitoring sites will be a minimum since any one monitoring site can monitor all down-links on a given satellite. In an international system with geographically separated hemispheric or zone beam (typically C-band) operation, several monitoring sites will be necessary since any one site usually will not be capable of seeing the down-links in other beams. The worst case operational conditions are in a spot beam environment typical of international Ku-band operation. Numerous monitoring sites will be necessary due to the reduced size of the spot beams and the ability of any site to monitor down-links in more than one beam.

7.2 REVISIT TIME

Revisit time is one of the most important parameters when considering the performance of an SMS. Revisit time is defined to be the amount of time between measurements on a particular carrier. If the revisit time is significant, the operating entities will notify the satellite network manager of a fault condition before the SMS indicates the alarm. The factors which affect revisit time are the type of monitoring equipment, type and number of carriers being monitored, transponder loadings, network architecture, number of monitoring devices, and transmission delays.

The monitoring equipment has a significant effect on the amount of time needed to accurately measure the bandwidth, center frequency, and power of a carrier. For power meter type monitoring equipment, monitoring time is independent of carrier type. Therefore, the time required to measure any carrier is the same. State-of-the-art power measurement equipment can provide carrier measurement times on the order of 0.1 seconds for any carrier (10). With spectrum analyzer type monitoring equipment, the size and type of carrier significantly effects measurement time. Typically, large bandwidth carriers require less measurement time than small carriers. This is due to the transient response of the filters within the spectrum analyzer which establish the resolution bandwidth. A wide bandwidth carrier is measured using a wide resolution bandwidth filter that has a faster response time than a narrow resolution bandwidth filter, which would be used to measure a narrow bandwidth carrier. For example, the time required to measure a 36-MHz video carrier is 0.3 seconds (8). On the other hand, the time required to measure a 20-kbit/s (40-kHz bandwidth) data carrier is 3.5 seconds (8).

Based on the carrier measurement times for the monitoring equipment, transponder loadings greatly affect revisit times. A transponder loaded with small data carriers will take significantly longer to characterize than a transponder loaded with several large carriers. Consider two scenarios: 1) a 40-MHz transponder loaded with a single video carrier and 2) a transponder loaded with 900 40-kHz data carriers. In scenario 1, it will take 0.1 seconds for the power meter and 0.3 seconds for the spectrum analyzer monitoring equipment

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to measure the video carrier. In scenario 2 the power meter will require about 90 seconds to perform the 900-carrier measurement while the spectrum analyzer will require about 53 minutes. This situation can be extended to the number of transponders being monitored on a particular satellite by a set of monitoring equipment. It is important to size the monitoring system to the type and amount of carriers being monitored to preserve a realistic revisit time.

The SMS system architecture affects revisit time in the respect of the computer processing time required. In a multitasking computer system, processing time is generally negligible unless the system is heavily loaded. In a centralized control type architecture this processing time would have the greatest effect, since a single computer is controlling the entire network. This constitutes a classic engineering trade-off, where revisit time is traded against a reduced amount of monitoring equipment and computer size. In the distributed control architecture, processing time has less of an effect on revisit time due to the additional control computers.

The number of monitoring devices in a given network greatly affects revisit time. This is independent of the type of control architecture used in the network. Given a multi-tasking control computer operating system, the monitoring equipment operates "simultaneously." With a large group of monitoring equipment, revisit time is reduced up to a point, since the carrier set assigned to any particular monitoring device is small. However, an excess of monitoring equipment increases the processing load on the control computer, which increases revisit times. Conversely, as the number of monitoring devices is reduced, the number of carriers assigned to any device increases, with a corresponding increase in revisit time. It is within reason to have a single monitoring device given the proper antenna resources, but in a large satellite network, the revisit times would be prohibitive.

Transmission delays play a role in revisit time in the sense that as commands are sent to a monitoring device from a remote control computer, delay is introduced by the transmission media used for communications between the devices. This can be minimized by proper communications protocols and system design. In general, this delay is not cumulative, since most monitoring devices receive commands as they are sending monitoring data to the control computer.

7.3 ACCURACY

The accuracy of the SMS is determined by the type of measurement equipment, the measurement method, the carrier type, and the monitoring earth station's gain to noise temperature ratio (G/T). A selective power meter used for power measurements has a typical accuracy of 0.2 dB (10) regardless of the carrier type. The accuracies associated with a spectrum analyzer vary, depending on the carrier type and measurement methodology. Typically, analog FM carrier measurements are less accurate than digital carrier measurements. Accuracies which can be expected from a spectrum analyzer based carrier measurement system are ±1 dB for power, ±10 percent of the nominal bandwidth and ±3 kHz, or 3 percent of measured bandwidth, whichever is greater (8) for center frequency.

Various measurement methodologies may be used to improve carrier measurement accuracies. A power meter-based measurement system only requires a filter of the correct bandwidth and a power meter to perform any measurement. On the other hand, in a spectrum analyzer-based system, there are a multitude of ways in which the spectrum analyzer can be configured to perform a given carrier measurement. Therefore, measurement methodologies can vary significantly. Generally, for the more difficult carriers (analog FM), several measurements are made of the same carrier and averaged to improve accuracy. COMSAT Laboratories has investigated the accuracies which can be expected from spectrum analyzer measurements. Measurements were performed on several different types of carriers by a number of experienced technical personnel. These personnel used their own procedure as well as a procedure developed at COMSAT Laboratories to measure each of the carriers. Digital carrier measurements were within ±0.5 dB of their actual value in both the non-procedure/procedure cases, while FDM/FM and TV/FM carrier measurements were in error as much as 15 dB in the non-procedure case and ±0.5 dB in the procedure case.

The sensitivity, or G/T, of a monitoring earth station, compared to that of a station for which a given carrier is destined, affects the accuracy and resolution of the measurement. It can be shown that a given carrier-to-noise change on a satellite link will result in a smaller change at the monitoring earth station than at the destination earth station if the monitoring station is of a lower G/T. The G/T of a monitoring earth station also affects the accuracy of any power measurement based on the ability of the monitoring earth station to "see" the noise floor of the transponder. If the noise introduced by the monitoring earth station masks the noise introduced by the satellite transponder, the relative level of the carrier (C + N) with respect to the transponder is not accurately known. The result is carrier power plus noise over noise ((C + N) / N) measurements which are lower than their actual values. Ideally, the G/T of the monitoring earth station must be good enough so that the noise introduced by the earth station does not hide the noise of the satellite transponder. This translates to large monitoring antennas and low temperature LNAs.

8. ADDITIONAL FEATURES

Numerous additional features are available on the satellite monitoring systems available. These features include automatic link calculations, statistical/trend analysis, spectral plotting, and remote antenna control.

The ability of the SMS to perform link calculations is quite advantageous when determining the problems associated with a particular carrier. C/N is an important parameter in all satellite links and can be translated into E_b/N_0 for digital carriers and S/N for analog FM carrier. These calculated values give the network manager an immediate assessment of the performance of the link. Additionally, from the satellite transponder side, satellite e.i.r.p. is an important performance indicator and provides the network manager information on the health of the satellite resource.

The statistical analysis of carrier parameters enables the network manager to predict problems before they happen. By logging the performance of a carrier over a period of time and averaging this performance, it is possible to detect trends. These trends indicate gradual increases/decreases in carrier power or variations in carrier bandwidth or center frequency. These potential problems can be investigated before resulting in down time on the link.

Spectral plots provide the operator with a window into the workings of the satellite transponder and the relative levels and spectral positions of the various carriers. Spectral plots of a single carrier, satellite transponder, or entire satellite spectrum can assist the network manager in finding spurious signals or carriers, determining relative levels in a carrier group, or determining the bandwidth/center frequency of any carrier.

The time that a carrier uses the space segment can be monitored using the SMS. This feature is especially useful for occasional use links. By accurately measuring the time a carrier utilizes the space segment, the resource provider can determine the correct space segment charge for a particular carrier. Note that this time can be no more accurate than plus or minus the revisit time.

Remote antenna control enables the network manager to monitor any number of different satellites with a single antenna and suite of monitoring equipment. In a multiple satellite network, multiple dedicated antennas are expensive and may not be necessary. A single antenna may be all that is needed to monitor the entire network. Depending on the size and traffic loading of the network, revisit time may become significant.

9. COMSAT'S SMS

The COMSAT SMS is intended for use in an international satellite network involving the INTELSAT space segment and various earth stations located in the United States, Japan, Taiwan, and the United Kingdom. This system has a centralized control type architecture as illustrated in Figure 7. The control and monitoring function is exercised from the COMSAT's Network Control Center at L'Enfant Plaza in Washington, D.C. The intent of the SMS is to enable COMSAT to monitor its inbound and outbound traffic over the INTELSAT satellites in the Atlantic and the Pacific Ocean Regions. The system will monitor video, IBS, and IDR type traffic. The earth stations located at Andover, Maine, and Clarksburg, Maryland, will have calibration equipment. The COMSAT system performs link calculations and statistical analysis; monitors carrier bandwidth, center frequency, and power; monitors the amount of time a carrier utilizes the space segment; generates spectral plots; and logs the performance parameters for the monitored carriers over extended periods of time.

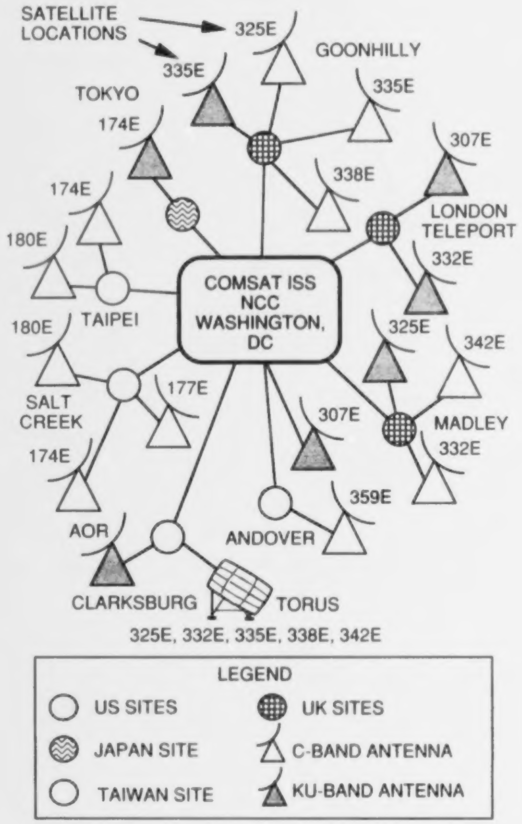

Figure 7. Distributed Processing Architecture

10. CONCLUSION

A satellite monitoring system provides the satellite resource provider with the tools necessary to manage the satellite network more effectively. With a properly selected group of monitoring sites and equipment a large satellite network can be efficiently monitored at a nominal expense. Information gathered by the SMS can provide an immediate indication of the condition of the satellite transponder as well as the performance of the carrier. In addition, this information can be archived and used for reference in predicting rain fade, random power, bandwidth, or center frequency fluctuations. It can also be used as an information source for expert system fault detection and correction. Today with the congestion on domestic and international satellite systems it is a necessity to be aware of the activities of all of the satellite users sharing the satellite resource. A satellite monitoring system provides this capability and improves the ability of the resource provider to efficiently use the satellite resource.

11. ACKNOWLEDGEMENTS

The author wishes to thank C. Mahle and R. Potukuchi of COMSAT Laboratories and C. Cotner and J. Martin of COMSAT ISS for their suggestions and critical review, as well as B. Alewine, C. Jeffcoat, and W. Schnicke of COMSAT ISS for their encouragement and support.

12. REFERENCES

(1) E. E. Steinbrecher and L. Gray, "A Computer Controlled Satellite Signal Monitoring System," *COMSAT Technical Review*, Vol. 1, No. 1, Fall 1971, pp. 79–116.

(2) J. R. Potukuchi, F. T. Assal, and R. C. Mott, "A Computer Controlled Satellite Communications Monitoring System for Time Division Multiple Access," *COMSAT Technical Review*, Vol. 14, No. 2, Fall 1984, pp. 391–430.

(3) S. N. Verma, W. F. Callanan, D. Hill, and P. Rossiter, "An Automated Satellite Carrier Monitoring System," GLOBECOM 82: IEEE Global Communications Conference, Nov. 29–Dec. 2, 1982, pp. 1279–1283.

(4) J. Bodie, "Automated Satellite Carrier Monitoring Systems," International Conference on Measurements for Telecommunications Transmission Systems, MTTS 85, Nov. 27–28, 1985 (IEE), pp. 128–132.

(5) J. V. Trethewie and M. Yuceozsoy, "Performance of a Communications System Monitor," International Conference on Measurements for Telecommunications Transmission Systems, MTTS 85, Nov. 27–28, 1985 (IEE), pp. 123–127.

(6) H. R. Irwin, "Monitoring Satellite Channel Performance—An Automatic System Based on the HP 8568A Spectrum Analyzer," IEEE Instrumentation and Measurement Technology Conference Proceedings, Jan. 17–18, 1984, pp.157–158.

(7) CALIAN, "Satellite Carrier Monitoring System, Detailed Description," Spring 1990.

(8) STANFORD TELECOM, "Transponder Access Control System (TACS)" STeL-TR-89518, October 4, 1989.

(9) SAT, "COMSAT ISS SATMON Satellite Monitoring System Technical Volume," April 25, 1990.

(10) PASCALL, "PASCALL Selective Power Meters, Series 4000, Product Description and Specification," Nov. 1989.

13. ABOUT THE AUTHOR

S. Bruce Wernek received Bachelor of Science degrees in Mathematics and Electrical Engineering in 1981 and a Master of Science in Electrical Engineering in 1986 from the University of Maryland, College Park. He joined COMSAT ISS in 1989 as a Senior Communications Systems Engineer and his assignments have dealt with interference analysis, satellite monitoring system implementation, spectrum analysis, and INTELSAT U.S. Signatory support. Prior to joining COMSAT Mr. Wernek was with Booz, Allen & Hamilton and provided satellite systems support to the U.S. Navy.

GUIDELINES FOR INTERNATIONAL DISTRIBUTOR SELECTION

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ABSTRACT

There are many aspects to find and select an appropriate off-shore partner. This partner could have a representative role, if the Company has off-shore technical resources, or it could be a Distributor, if the Company is primarily based in its own country. The following gives an overview of the steps required to be taken in this selection process.

Qualify Target Countries

- ability to pay in US dollars and afford the product/service being offered.
- number of multinational corporations, institutions and local entities which need and can afford to pay for improved communications
- number of geographically dispersed organizations which require private communications networks and have the ability to pay in dollars
- country's communication policy
  - can a private network exist
  - who may own earth stations
  - who has landing rights
    - Pan American Satellite
    - Intelsat
    - Others
- U.S. Products can be exported to
  - Stable government
  - Regulatory Agencies (P.T.T's)
  - Private Companies

Two Approaches

1. Company

Once a country is selected, the Company will hire an employee who is trained to become the local liaison between Company customers and representative. This individual will be trained at Company Headquarters and move back to the country to manage the local office to be established after the Distributor is selected. He will also manage and control the locally-based spares inventory which will be maintained by the Company to assist the Distributor with servicing the local accounts. He will also be available to go on sales calls to support the Distributor.

a. Company needs to select a local attorney.

b. Company needs to register its name and trademark for products and services in the country.

c. Company needs to trademark its name and products in the country.

d. Company needs to establish a local subsidiary if a branch office is not permitted.

2. Selecting a Business Partner

Company will identify several qualified business partner candidates. A team from the Company will interview and screen the candidates, in their country, to make the final selection. At the appropriate time, sample business agreements will be presented to the finalist for review and closing selection.

Prospects should have the following qualifications:

- must be established
- financial credibility
- integrity
- technical know-how on satellite systems and other communication products

- contacts with the country's regulatory authorities including working knowledge of P.T.T's.
- appropriate marketing and sales support including proposal production, etc.
- established maintenance/installation organization or the ability to establish one
- have established offices
- have a local import broker contact

Business Arrangements

Business arrangements with a Distributor cover the following activities:

a. evaluate political and economic territory for trade barriers and licensing standards
b. seller of equipment
c. provider of import/export licenses
e. provider of regulatory approvals and communication licenses
f. provider of installation services
g. provide operator training to customers
h. provider of maintenance and repair service
i. provider of pre-sales support for sales calls, budgetary quotes
j. check credit references and business references of potential customers

All of these activities are designed to generate revenues for both Company Corporation and its Distributor.

Duties of the Distributor

- promote the Company name, products and services
- generate both equipment and service revenues
- provide a sales and maintenance organization
- not handle competing lines to Company
- must generate a minimum volume of business to maintain exclusive rights
- supply quarterly business reports to Company
- assist Company to register its name and trademark for products and services in country
- to assist Company in protecting same in-country

Duties of Company:

- sales tools
- equipment and service training for Distributor
- U.S. regulatory and licensing accommodation
- proposal generation as required
- network design collaboration
- pricing of equipment and services
- support of promotional activities
- sales call support
- installation service support
- shipping of equipment and spares
- prepare export documentation and follow through

Seller of Equipment

The preferred approach to selling equipment to Distributors or end users is for the Company to receive Letters of Credit. The Distributor will identify prospective customers, promote the company's products and services to local customers and solicit orders.

Except for the Company's OEM arrangements, if applicable, the Distributor will be the Company's only representative in the country providing certain minimum revenue levels are met. For the OEM arrangements, the Distributor only handles installation and maintenance of hardware shipped into the country and only gets a small negotiated commission. In the event the order originates outside of the country, the Distributor will receive a negotiated commission . Conversely, if the Distributor generates an order which is shipped and installed in another country, then the Distributor would receive a negotiated commission for generating the order.

In certain cases, the customer may insist that the sale is direct to the Company. In such cases the Company needs to get an agreement from the Distributor to accommodate this local customer. The important thing is that in-country and the Company price to the customer is the same. The Distributor would then receive from the Company a negotiated payment which would be less then the normal discount. The Distributor would do install/maintenance to make up for the discount hardware price.

In certain countries, the Company, with the Distributor, may find it appropriate to establish an additional distribution level such as the P.T.T. to sell the equipment. In such cases, prices need to be marked-up to appropriate levels, consistent with the local environment so that there is sufficient discount.

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Import and US Export Licenses

The Distributor will obtain the import license for the customer while the Company obtains the US export license for the shipment.

U.S. import/U.S. local export services will be charged at a certain percentage of the cost. Import services will be billed to customer according to a percentage set by Distributor.

Distributor will pay for all import fees on return-to-factory for repair if customer is on maintenance contract. If customer is not on maintenance contract, Distributor/Company will charge customer a certain percent of the handling charge plus import fees.

Distributor will prepare or have prepared the required documentation for importing which in most cases is needed to begin U.S. export documentation approval.
Company will apply for the export license and follow-up as to status, etc. to ensure appropriate regulations are met prior to out of country shipment.

Regulatory and Communication License Approvals

Company and the Distributor will provide the services to obtain the necessary regulatory approvals both from the US and in-country regulatory agencies. The fees for this service vary depending upon requirements. These will be shared equally between Company and the Distributor. Company will obtain the US approvals and licenses while the Distributor will obtain the local communications licenses. Company will assist the Distributor with any technical information required by regulatory agencies.

Installation/Integration Service

Company will provide training to the Distributor to either manage or directly provide:

- network design
- site survey
- installation drawings
- installer subcontract
- installation of equipment
- integration of certain equipment
- architectural and engineering packaging
- maintenance procedures
- troubleshooting

The price for these services depends on the size of the installation and on pre-arranged pricing agreed upon by the Company and quoted to the customer. These installation and local integration fees, for example, could be shared as follows:

Distributor	75%
Company	25%

For its 75% portion of these fees, the Distributor will provide or pay for the local installation, notify company of install dates, meet installation schedule and conduct acceptance tests. For its 25% share the Company will provide the installation support to the Distributor and certify that equipment has been tested and pass quality assurance before shipping and issue complete packing lists and shipping information and documentation.

Operator Training to Customer

- In-Country

Company will provide training and training support materials to the Distributor so that the Distributor can conduct local training classes for customer operators. The local training revenues, for example, could be shared as follows:

Distributor	75%
Company	25%

The Distributor will conduct the classes and Company will provide the support material for its share of the training revenue.

Company will periodically review training procedures.

- Company Location

Training can also be done at the Company's headquarters depending what is appropriate , particularly if the customer requires other vendor training at the same time. This will also depend on if this is an initial start up period for the Distributor where more support is required. The training revenues, for example, could then be:

Company	75%
Distributor	25%

Maintenance and Network Operations Service

The Distributor, with the help of the Company, as required, will provide a maintenance program service which will assure that the customers' equipment, in the country, is maintained with maximum up-time. This service provides a growing revenue source for both the Company and the Distributor. There are three methods of supplying in-country spares stock:

1. Distributor will stock spares to support the install base as well as a service. The Distributor will establish a group to handle the replacement and/or repair of the equipment.

2. The Company supplies the spares to the Distributor at no charge providing the customer has purchased an annual maintenance program based on total price of equipment. Part of the total price pays back the retail price of spares, plus interest, to the Company. The Distributor would then charge for labor only as the other part of the total maintenance package.

3. In the event the customer elects not to purchase the annual maintenance program, the spares are sold to the customer and the Distributor would then charge for a labor only maintenance program.

Payment Terms

This is an example of payment procedures that could be used.

1. The purchase price of the Equipment could be paid as follows:

Fifty percent upon placement of the order by Buyer, with the latter 50% by Letter of Credit, 40% of which is upon shipment of hardware equipment from Company's F.O.B. point or points. The remaining 10% upon completion of the Ready-for-Use demonstration. If the Ready-for-Use demonstration is delayed by Buyer, the Equipment will be shipped in place and final payment is due at the end of the sixty-day period thereafter. Seller will store and insure Buyer Equipment at the then-current storage rates.

Payment for the equipment could be made by Letter of Credit.

If the Buyer's account is insurable through the Foreign Credit Insurance Associates US Export Import Bank, then the payment terms can be negotiated.

2. The purchase price of installation services could be paid as follows:

Fifty percent upon placement of the order by Buyer; 50% upon completion of the Ready-for-Use demonstration. If the Ready-for-Use demonstration is delayed by Buyer, final payment for installation services is due at the end of the sixty-day period thereafter. Final payment for installation services shall be made by Letter of Credit or wire transfer.

3. The purchase price of System Services could be paid to Seller (Company or Distributor) within thirty (30) days after the date of invoice. A finance charge for payment after thirty (30) days would be assessed at the rate of one and one-half percent (1 1/2%) of the unpaid balance per month. Payment for System Services could be made by wire transfer.

4. Buyer could then be invoiced monthly in advance for Network & Maintenance services. Payment would be due on the first of the month for which service is provided and made by wire transfer.

Summary

There are numerous ways to negotiate and maintain the Company standard requirements to be kept by the Distributor or Representative. The above are some standard methods which have been successful for myself in setting up Distributor/Representative off-shore networks. It is a matter of putting in place what each partner, the Company and the Distributor/Representative, can do as well as being comfortable with each other. Each side has to "win" in any business relationship otherwise you don't have a partnership. This is especially true when the off-shore partner is 10,000+ miles away.

The other part which is extremely important in keeping both partners in the "know" is **communication, communication, communication.** I cannot stress this too much when the off-shore partner can be many thousands of miles away.

Too often companies tend to put aside the international Fax or phone call and answer back in several days, sometimes weeks, depending if the message got "buried" in the pile of paper work or just forgotten because of another "rush priority." This is how off-shore customers are lost, in fact Distributor/Representative as well. The Distributor is supposed to be representing the Company and when they need assistance for technical support or making sure the appropriate paperwork is being handled, the need is **now** not days/weeks away. This type of "limp support" will eventually kill the potential and/or ongoing business in the country because the Distributor/Representative "loses face" in their business community and won't be trusted by the local business to finish a project.

These selected groups will be very important to the overall success and penetration, by the Company, into the international marketplace. This is one of the main reasons why it takes a certain period of time to select the appropriate in-country partner who can assist the Company in a geographic area. This assures the partner is large enough to handle the various aspects above is critical to the Company being successful.

The Company would then continue to develop these alliances to strengthen their capabilities in communications, network management and service to the expanding customer base.

The Company would use a systematic approach in expanding the customer base to other countries by making sure that the quality of service to the customer can be obtained and maintained. It is a very important point to ensure customer satisfaction, particularly when their network is in many foreign countries, and in some cases not rapidly accessible to the home office. The other important aspect is timely strong technical support both at the Distributor level, but even more so from the Company.

There are also variations, for any business partnership, to the above guidelines, but it will get a Company started in the right direction..

Remember it takes a strong commitment by the Company to expand their marketplace offshore and as long as that commitment is met the Company should be successful.

INTERACTIVE TELEVISION VIA SATELLITE AND HIGHER EDUCATION IN MEXICO: THE MONTERREY TECH EXPERIENCE

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1. ABSTRACT

This paper describes the Interactive Education by Satellite System developed by Monterrey Tech in Mexico and provides ideas that could be useful for other higher education programs in Mexico and other countries.

2. MONTERREY TECH INTERACTIVE EDUCATION BY SATELLITE SYSTEM

2.1 MONTERREY TECH

The Monterrey Institute of Technology and Higher Studies, known commonly as Monterrey Tech (MT) is a 26 campus private university system that covers 24 cities all around Mexico. Its main academic areas are engineering and business administration, but it also offers more than 30 majors in different disciplines, including arts and humanities. Founded in 1943, MT now has enrollment of over 45,000 students in undergraduate and graduate degree programs.

Its first and main campus is located in Monterrey, the Mexican industrial center. With more than 13,000 students, the Monterrey campus seems very much like an American college. It has advanced computer technology rivaling any large American college as well as impressive facilities for teaching and research in several technical areas. Monterrey Tech's second largest campus is located in the metropolitan area of Mexico City.

2.2 MONTERREY TECH AND THE MEXICAN HIGHER EDUCATION SYSTEM

Monterrey Tech is by no means a prototype of a Mexican University.
Mexico has good human resources in both educational and research fields, but in Mexico higher education is in a crisis due to a disorganized growth spurt. From 1959 to 1986, for example, the total enrollment in Mexican universities grew 83.6 percent, and from 1966 to 1973, the rate was 169.2 percent. Now, the state universities such as the National University of Mexico, which has an enrollment of a half a million students, are setting all time high enrollment records.

While the student population grew at a fast pace, faculty as well as teaching and research facility development has been much slower. This situation worsened in 1982 when an economic crisis shook the country's finances. At the present, Mexico has large universities with enormous student enrollments and a limited amount of well-prepared faculty members and adequate facilities.

Monterrey Tech also grew fast. Fifty years ago it did not exist at all. Nevertheless its growth has been unlike the public universities in Mexico. MT continues to offer a high standard of education, but still finds it extremely difficult to continue to recruit good faculty. Traditionally, faculty members of Latin American universities are hired on a part-time basis and continue to work for industry while teaching. Early on, MT decided to forgo tradition and opt for full-time faculty. Up until the last ten years this method has been successful for MT. The demand for degreed professionals is much higher than the supply, thus it is extremely difficult for MT to offer a competitive salary to entice degreed professionals away from industry jobs.

Mexico is aware that education is a key element in its development, especially now when it is facing the possibility of a free trade agreement with the United States. Nevertheless, the situation of its educational system is critical and only non-traditional approaches can be the answer to the immediate problems.

2.3 THE INTERACTIVE EDUCATION BY SATELLITE SYSTEM STORY

In 1988 MT conducted a self-study as a requirement for the renewal of its 30-year long membership to the Southern Association of Colleges and Schools (SACS). It found that about 30 percent of its faculty had only a bachelor's degree, and less than 25 percent had a doctorate. Since SACS accreditation is very important for MT graduates who want to pursue advanced studies in the United States, it decided to face the faculty problem and established an important goal: In less than five years, all the faculty members must have at least a master's degree. In order to accomplish the goal, MT implemented an aggressive faculty development and recruitment program.

Faculty who were willing to leave the country to attend American and European universities to pursue advanced degrees were financially supported by MT. Some faculty members who lived in small towns were not able to move. The Interactive Education by Satellite System (IESS) was initially developed to help these individuals pursue advanced degrees without leaving home.

2.4 THE MEXICAN TELECOMMUNICATION SYSTEM AND ITS EDUCATIONAL POTENTIAL

Among the third world countries, Mexico has one of the most complete telecommunications infrastructures. Its microwave network covers almost all the country. More than 900 radio stations and 200 television stations provide news and entertainment to a population of over 80 million. Despite its poor quality, the telephone system has grown very fast and now almost one out of every ten people has a telephone. A major element in Mexican telecommunications is the Morelos satellite system. Since 1985, Mexico has its own satellite system and this has allowed the operation of voice and data private networks, and supported national coverage of television networks on two government owned satellites.

Mexico has conducted several experiments with education programs using telecommunications, both at the formal and the informal level. The Telesecundaria, for example, is a distance education program that provides secondary education for people in rural areas. Commercial television has used the popular telenovelas (soap operas) as developmental communication strategies and this experience has been widely followed by many other countries.

Monterrey Tech has had experience with educational television long before the development of the IESS. During the '60s and '70s, it operated a closed-circuit television system that transmitted advanced course lectures. As a result of this early system, MT realized the interaction component, a key element in the educational model, had been missing. The IESS system was designed to take care of this oversite.

2.5 IESS EDUCATIONAL MODEL

When MT decided that a non-traditional educational approach had to be used to face its faculty problem, some guidelines were established.

a. The system had to be used to teach graduate courses that, through two or three years, lead the students -in fact, actually faculty members in different campuses- to a master's degree.

b. This system had to employ the teaching talents of the highest rated faculty with doctorate degrees in specialized disciplines to teach undergraduate courses.

c. The system had to be interactive since the previous television experiences had demonstrated that interaction was a key element in education.

d. The system had to cover simultaneously all the campuses, widespread all around the country.

e. The system had to be cost-effective.

The resulting design was a distance education model based on one-way satellite delivered television instruction with two-way audio and data interaction. IESS uses satellite transmission to cover all the country and in order to be cost-effective with a point to multi-point system. The interaction is done through the satellite based voice and data private network that MT has operated since 1987.

Two classrooms were designed at the Monterrey campus as studios, and one at the Mexico City campus. A group of about eighteen students take the course in the transmitting classroom. This design allows the instructor to have immediate feedback from the students and reduces the stress that instructors feel when they have to look directly into the camera. The instructor has an assistant whose duty is to monitor the interaction with students from receiving campuses.

At each receiving campus there is a person responsible for the course who takes care of the distribution of materials, the receiving and communication devices and helps the students send their questions and comments through the voice and data network.

Besides the in-class interaction capability, the use of Bitnet allows the students to interact with their instructor in an "office hours" type set-up. The advantage to this method is that it can be both synchronous and asynchronous.

The instructor does not use a blackboard. Instead, an overhead camera displays an area on the instructor's desk where he/she can show prepared materials or write notes during the lecture.

2.6 IESS TECHNICAL MODEL

Two main components can be distinguished in the model: the transmission and the interaction. Each of them has its own design.

a. Transmission: For the transmission of the television signal, a C-Band full transponder on the Morelos 2 Satellite is used. Neither Monterrey nor Mexico City campuses have up-link facilities, and thus lease this service. Both campuses have a microwave link to a teleport. For down-link, each of the 26 campuses has its own receive station.

b. Interaction: For the interaction, IESS uses the satellite-based voice and data private network that MT operates through the Morelos 1 Satellite, in Ku-Band. This network operates 24 hours a day and covers all the campuses. This is an important element for cost-effectiveness since it eliminates the use of commercial telephone lines.

Interaction occurs both via voice or data. The voice system is like any telephone system, except that there is a delay in the conversation that is bothersome for some of the students. The data system is managed by a specially designed software that receives and processes written questions and comments from all the campuses. The advantages of this method are that it does not interrupt the instructor and that questions can be filtered by the assistant, who acts like a gate-keeper. The disadvantage is that it requires more time for the student than the use of a telephone.

2.7 ORGANIZATIONAL MODEL

The design and development of IESS implied the involvement of many people from different areas, but its organizational model was defined in the following way:

a. Academic coordination: A system-wide office responsible for all the aspects related to the programming and evaluation of the courses, as well as the distribution of materials.

b. Coordination of operation: In each of the two transmitting campuses there is an office responsible for the operation of the system.

c. Receiving campus coordination: In each receiving campus there is a person responsible for each course.

d. Academic departments: The academic departments are responsible for the courses they teach, as if they were traditional courses.

e. Television services: A group of producer-directors with a manager are responsible for the TV production of the courses.

f. Telecommunications and information services: A group of engineers responsible for the engineering aspects of the communication.

g. Academic support. A group of designers and artists who prepare support material for the courses. It includes print material, computer graphics, computer animation and multimedia applications.

2.8 DATA ABOUT IESS

In three full semesters and two summer periods, IESS has transmitted over 700 hours consisting of 19 courses in three graduate fields of study, with almost 200 faculty registered as students for credit.

IESS has also transmitted 16 undergraduate courses with an enrollment ranging from 70 to 350 students by course. Additionally, more than 150 hours of teleconferences have been transmitted in support of undergraduate programs in engineering, computer sciences, finance, management, ethics and humanities.

2.9 EVALUATION OF IESS

During its first year of operations, no formal evaluation of IESS was conducted. At the beginning of the fall semester of 1990, an information system providing continuous data about any relevant aspect of the project was implemented. Information about the number of student responses from receiving campuses, student performance, student opinion about the system, use of support material, technical problems, etc. is collected. This information system will be the base for formal research and for decision making about the future of the project.

In an informal way, it has been clear for MT administration that the project has been successful in its first stage. Now, new steps have to be given in order to improve the system.

2.10 FURTHER STAGES OF THE PROJECT

The first stage was to begin operations and demonstrate that this kind of educational model was feasible in Mexico and for MT. The basic concern was design and operation and there was no room for research.

The second stage implies conducting research in order to better understand what it is happening with the model and to suggest specific ways for improvements. The first step in this stage is the implementation of the information system.

The third stage will be the enrichment of the system. This means, the continuous search for new technological and educational opportunities to improve the quality of the model. Further developments in telecommunications are expected to be very helpful in this stage.

3. LESSONS FROM MONTERREY TECH EXPERIENCES

In spite of the lack of formal research, Monterrey Tech experiences with IESS present some ideas that could be useful for other higher education institutions in Mexico and other countries.

3.1 THE PROBLEM OF INTERACTION

Although the technology allows interaction in this kind of distance education model, it cannot be of the same caliber as in the classroom. That is why the educational model has to compensate the low level of dialogical communication with a higher emphasis on the planning of the instructor's messages. One instructor, for example, wanted to use IESS to convey a seminar course in which students had heavy participation. This course was a complete failure and it showed that the kind of course more appropriate to this project is the lecture type course, with limited student participation.

3.2 TECHNOLOGICAL ASPECTS

Since MT was under tremendous pressure to start IESS operations, it was not possible to make an in-depth study of the technology available. For this reason, the basic technical design is similar to commercial broadcasting. Nevertheless, in the future MT expects to change from C-Band to Ku-Band, and to use compressed video technologies that allow two way video and audio interaction and/or the reduction of the band width required for transmission. During the near future, an easy access to the Mexican telecommunications system for educational uses is expected, since MT has opened the pathway. However, as long as other institutions begin to require the services, especially those implying satellite delivery, the options will reduce dramatically. This is a good time to make decisions.

3.3 COST

MT had to spend about four million dollars on the hardware project, including up-links and down-links in C and Ku-Bands. Part of the hardware is used for other purposes and so IESS cost is reduced significantly. Certainly, this is a high investment for a university, but in addition to the internal use, the university could use the system to offer training programs to industry, partially recovering initial system costs. Join ventures between universities are also another alternative to paying for this high investment.

3.4 IMPACT ON THE FACULTY LABOR

During the first stage, IESS has been transmitting courses in which there is a shortage of faculty.

At this point in the project, faculty members are not being displaced. However, the amount of key faculty positions would be less prevalent. Faculty members must understand that this kind of educational model demands more of their time be spent on non-traditional teaching duties. In the context of IESS, for example, faculty will be more than instructors: they will be educational designers using the tremendous potential of the new technologies.

If an innovation like this one is not introduced properly to the faculty, it can be rejected and blocked. This introduction requires special training for faculty in the use of technology as educational tools.

3.5 THE RISK OF BEING TRAPPED BY THE TECHNOLOGICAL DETERMINISM

It is extremely important to avoid the technological determinism. This term means that some institutions could think that the use of high-tech in education is a guarantee of quality and success. Technology is a tool and has to be used intelligently. It is a mean and not an end.

4. IESS AND THE FUTURE OF MONTERREY TECH

Monterrey Tech has been during all its history an innovative institution. Now, the IESS project is an incentive to continue with the search of better ways to do the educational job.

Monterrey Tech began to use telecommunications technologies in education to solve an internal problem, but now, it has opened the door to the international world. With its membership to National University Teleconference Network (NUTN) and National Technological University (NTU), as well as through other bilateral agreements with universities and institutions, Monterrey Tech has now a wider spectrum of possibilities to enrich its educational labor.

In order to face the international challenge, MT is planning to build a new facility in the next two years where the future of education will be transformed in a present reality.

Three major elements will be interacting in this project: the knowledge about educational phenomenon; the computer technology to improve the educational activity; and the telecommunications to get access to the Global Network.

REFERENCES

Kuhlman, Federico; Antonio Alonso; Alfredo Mateos. Comunicaciones: Pasado y Futuro. Mexico: Fondo de Cultura Economica, 1989.

United Nations. 1988 Demographic Yearbook 40th ed. New York: United Nations, 1990.

OFFERING A GRADUATE PROGRAM IN HIGHER EDUCATION VIA DISTANCE LEARNING

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1. ABSTRACT

This paper describes one effort to deliver a graduate program in higher education studies to university staff and administrative personnel via distance learning. Both the need for the training and development of collegiate middle management staff and the content and orientation of such programs are explored. The authors describe the delivery of a masters level academic program to students at five remote sites via an interactive television system.

2. INTRODUCTION

Staff and administrative personnel in colleges and universities are a neglected human resource. Despite their educative mission, academic organizations have not committed significant resources to the development of their administrative staff members. Higher education has traditionally lagged behind the private sector in the training and staff development of its personnel. Given the history and structure of the academy, this is not surprising. Colleges and universities were founded by and for faculty and students--administrative positions have been created as a necessary, but not always welcome, addition (1, 2). Since the early 1900's faculty have been railing against the proliferation of administrators, their control of the academy, and their increasing share of limited resources. Committing scarce resources to the development and training of these administrators has not been a priority.

3. NEED FOR TRAINING AND DEVELOPMENT

The number of administrative staff members, particularly at major research universities, has increased dramatically in the last two decades (3), and the faculty continue to rail. Nonetheless, with growth in governmental regulations, new populations to be served, and increases in external pressures, universities have been forced to add staff in order to accomplish the non-academic tasks that support the academic core.

Many of these newly created positions are filled by candidates from outside of higher education. They come from government agencies, the private sector and other non-profit organizations. Most entry and mid-level administrators are hired for a specific functional expertise. They may be accountants or counselors or programmers by training but most typically they know very little about the context and culture of the academic organization. They know virtually nothing about the structure and governance of the academy; they often do not appreciate the multiple missions of the research university; and, they certainly do not understand the nature and scholarly functions of faculty members. Thus, the issue in the training and development of administrative staff is not only a matter of increasing skills but also of enhancing understanding of the academy.

Collegiate middle managers have been shown to be oriented to serve faculty and students, committed to their career in the institution, and generally satisfied that they are competent and achieving results in challenging work (4). Nonetheless, they often express frustration regarding their lack of authority, recognition, and rewards. Low morale, poor performance, and high turnover in the entry and mid-level administrative ranks are perennial concerns in many academic organizations. Unfortunately, senior level administrators, who come out of the faculty ranks, rarely perceive the human resource dimensions of these concerns. Training and development efforts are one approach that can serve this group of employees as well as the academy. One means of providing such development is through academic programs in which both skills and understanding of higher education organizations can be enhanced. A masters or doctoral program in higher education can emphasize administrative training within the unique context of an academic organization.

4. THE CASE OF HAWAII

The state of Hawaii presents unique problems in the delivery of such programs. With one state university system serving seven islands, the recruitment, training and retention of able and qualified administrative staff is a challenge. Entry and mid-level administrators are recruited from regional labor markets (as opposed to the national markets from which faculty and senior staff are drawn); thus, Hawaii's geographical isolation exacerbates the difficulty of recruitment. Moreover, the exceedingly low unemployment rate in the state makes it all the more incumbent upon the employer to make the work climate attractive in order to retain personnel.

Given this context, the training and development of administrative staff employed within the university system is a pressing need. Meeting that need in an island state requires extraordinary efforts. Access to training and academic programs is severely limited for all the islands except Oahu. There have been no graduate programs offered on any other islands. Thus, delivering a higher education program to the neighbor islands requires breaking new ground.

The higher education program itself is relatively new. The program emphasis in higher education administration exists within the Department of Educational Administration on the Manoa campus. The program at the master's level is built around the three core areas of emphases: human factors in academic organizations, the management of higher education functions, and the legal/fiscal issues of higher education. In addition to these areas, students are required to develop skills in research and evaluation. The culminating activity required to demonstrate masters level learning is either an original research project or an original case analysis.

The audience for this program emphasis has grown steadily since the early 1980's. The majority of those enrolled have held positions as entry or mid-level administrators on the Manoa campus, in one of the community colleges on Oahu, or on one of the three private colleges on Oahu. The first effort to deliver the program to administrators on neighbor islands occurred in 1987 when a series of five courses were offered on Hilo, and subsequently on Maui. The response was excellent with roughly twenty-five students enrolled in the introductory course on each island. At that time, delivery entailed flying an instructor to the island for each class session. To reduce the cost of airfare, classes were scheduled as marathon sessions, usually three hours on Friday evenings and five hours on the following day every other week for six weeks. Advising and consultation occurred before or after class or by telephone. The wear and tear on instructors and students was evident. Another drawback was the limited offerings. Five courses were offered as a staff development opportunity but most students wanted graduate degree programs. To complete their degrees entailed a major commitment of residing on Oahu to attend Manoa classes.

5. HAWAII INTERACTIVE TELEVISION SYSTEM

The advent of Hawaii Interactive Television System (HITS) has provided a delivery system that for the first time ensures neighbor island students access to graduate education. More to the point, it provides a means of delivering a graduate program in higher education administration that can meet the training and development needs of current and potential administrative staff throughout the university system.

The initiation of the program occurred in the summer of 1990 when the first two courses were offered over closed circuit television simultaneously to Maui, Hilo, Kaui, and to two sites on Oahu, the Manoa campus and the Leeward campus. Despite the difficulties of a brand new technology, instructors who were using the technology for the first time, and students who were as skeptical as they were eager, the initial effort went surprisingly well. The technicians learned to move with the instructors, and the instructors learned to adjust their presentations to the delivery system. One of the difficulties of launching the effort was to convince faculty that they could do it effectively. Both the idea of being "on television" and of being "removed" from students are inhibiting factors. Faculty have usually cultivated a style of presentation over some years of teaching, and they are not motivated to spend time adapting the content or their delivery to a new technology. The program coordinator is then caught between convincing faculty they can do it and that it won't require an inordinate amount of their time in redesigning their courses, and convincing them that they do need to spend some time preparing specifically for the new technology.

Adapting overheads to the size of the monitor, structuring small and large group discussions to include all the students on all the sites, and learning to juggle faculty and student interaction on the sites so all of the students feel included in the class are essential to the success of the class--but they are not overwhelmingly difficult. They require practice and the feedback of trained technicians willing to work with the faculty to improve the delivery. Access to electronic mail and fax machines allows instant and on-going communication between faculty and students as well as between students enrolled in the same class. One of the unexpected outcomes is feedback from students on the neighbor islands that they actually prefer the interactive system to "traveling faculty." They feel geographically and professionally isolated; they rarely have the opportunity to interact with their peers throughout the state. Coursework via interactive television gives them the opportunity to meet and discuss issues of professional concern with their counterparts from other institutions.

There are glitches. Equipment does fail, faculty don't always plan ahead, and technicians do make mistakes. It is not easy to respond to the cameras and monitors exactly as one does to warm bodies in a classroom. Not all course content adapts as easily to the technology. Most recently, we have had a problem with students choosing not to attend class and watching the videotapes of the sessions they miss at their convenience. Although this certainly provides maximum flexibility for students, the courses are not designed as correspondence courses but as interactive courses. We now need to think through how we structure the courses to ensure that expectations regarding attendance and participation are made explicit. Another problem is access to library resources in remote areas--a problem soon to be addressed with the advent of CARL (Colorado Alliance of Research Libraries) system of library information, automation and retrieval which will provide the access to resources critical to graduate education.

Despite the problems, we are exceedingly optimistic about the potential of interactive television for delivering a program of study in higher education. Although it is difficult to assess the number of persons sufficiently interested in graduate education to complete a degree program, it is clear that there is a great deal of interest in training and development opportunities in higher education. We are now able to serve that interest as well as to realize a more broadly-based goal: to increase understanding of the academy within the campus community as well as in the larger community.

6. FUTURE DEVELOPMENTS

Since the advent of the higher education program via HITS, two courses have been offered each semester, and enrollments are growing. We are currently projecting multiple year offerings to enable students to plan their coursework from entry to completion. As we look to the future and improved technology, we envision the potential of providing graduate training in higher education throughout the Pacific Rim. Students who now journey to Hawaii for extended study from Guam, Micronesia, the Marshals, Northern Marianas, Samoa and beyond from Asia, Australia and New Zealand could potentially pursue such coursework at home sites. The potential for interactive training in higher education that capitalizes on an international perspective is real. Higher education organizations will be enhanced as administrative staff participate in training and development that emphasizes global understanding of the issues and concerns critical to the academy.

7. REFERENCES

1. Rudolph, F. (1962). The American college and university: A history. New York: Random House, Inc.

2. Veysey, L. R. (1965). The emergence of the American university. University of Chicago Press: Chicago.

3. Johnsrud, L.K. (in press). Administrative promotion: The power of gender. The Journal of Higher Education.

4. Scott, R. A. (1978). Lords, squires, and yeoman: Collegiate middle managers and their organizations. AAHE-ERIC/Higher Education Research Report No. 7. Washington, D. C.: American Association for Higher Education.

IMPROVING THE SUCCESS OF FACULTY DEVELOPMENT IN DISTANCE EDUCATION

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Abstract

Faculty development is critical to the success of the distance education enterprise. This paper discusses the role and importance of faculty development and describes 15 characteristics of effective in-service faculty training programs.

Designing, developing, and implementing effective faculty development programs is the most efficient pathway to long term, instructional success in the field of distance education.

For purposes of the discussion, "distance education" occurs whenever teacher and students are not co-located. Although the term faculty development has been referred to in various contexts, its definition is generally concerned with enhancing the talents, expanding the interests, improving the competence, and facilitating the professional and personal growth of faculty members, primarily in their role as instructors (1).

The field of faculty development has evolved significantly since its inception. Past approaches appeared to focus on the symptoms of the problem (i.e., disenchanted students, falling enrollments, etc.) as opposed to the problem itself: the lack of teacher effectiveness training. As a result, early efforts in the field of faculty development were concerned with curriculum change, recruiting brighter students as well as new doctoral faculty, reducing the student/faculty ratio, and developing instructional resource centers (2).

Faculty development strategies in recent years have taken a different approach by focusing on the improvement of instructional quality. Other practices attempt to help the faculty members to better understand themselves as teachers and individuals as well as the institution in which they work (3).

If the need for, and inherent challenges of, faculty development are important in traditional (e.g., face-to-face "live" instruction) classroom settings, it is truly imperative in non-traditional settings in which distance delivery methods are employed (i.e., instruction by audio, print, computers, television, etc., or a combination thereof) . While few would dispute that course content remains fundamentally unchanged regardless of delivery method, those with distance education teaching experience would likely echo the claim that thoughtful course adaptation is required if the distance delivered instruction is to be effective.

For example, many distance delivered courses are intended to serve a learner audience with characteristics quite different from those students usually enrolled in traditional classroom environments. As such, their backgrounds, experiences, and educational goals might vary significantly from their traditional student counterparts. The effective distance educator will take these unique learner characteristics into account and develop/adapt instructional strategies responsive to the unique mix of learners.

If the scope of the distance education enterprise is statewide in nature and intended to meet the needs of rural and urban learners from widely different educational, cultural, social, and economic backgrounds, the challenges faced by the instructor increase exponentially. Without an understanding of the targeted learners and an ability to look at the content through their eyes, instructors are at a distinct disadvantage that may divert them from future distance education endeavors.

An additional and perplexing faculty development challenge relates to the technical and administrative infrastructure in place at many institutions. Under the guise of expedience, administrators seldom consult faculty in the early stages of distance education planning. Although much time is spent convincing funding agencies, governing boards, politicians, and fellow administrators that distance education technology is the "solution," faculty are seldom consulted as to the nature of the "problem." And given that a poorly defined problem has an infinite number of solutions, faculty members are often expected to make a system function that they had little input in planning and that may or may not be instructionally appropriate.

Typically, administrators realize this conundrum after the technological system is in place. The administrative reality dawns slowly that without the interest, support, and enthusiasm of the faculty, a distance education program is doomed to failure, regardless of its technological sophistication.

Enter Faculty Development and the realization that many in-service training programs are instituted in a reactive as opposed to proactive manner.

In-service faculty training programs take many forms. At some institutions, one-to-one sessions are used, while others rely on self-paced materials, or campus-wide faculty development workshops. In terms of content expertise, some schools use "outside" consultants and content experts, while others rely on internal resources for the development, adaptation, and implementation of distance delivered instruction. Still others blend outside expertise with internal support in creating an atmosphere of mutual support and group problem solving.

Regardless of the format or institutional approach to faculty development, successful distance education in-service training experiences should share many of the following characteristics:

1. Faculty participants should be encouraged to share concerns and question the administrative expectations of the technical system. Of equal importance is the honesty with which their concerns are addressed. Administrators should avoid excuses for not involving faculty earlier in the planning process and frankly discuss how the distance delivery system evolved and its role, as envisioned by planners. Ideally, a formalized needs assessment will have been previously conducted and can serve as a combination rationale for change and blueprint for action.

2. Technical systems should be described in the language of the user, not the technician, and incorporate easily understood and jargon-free language and related visuals.

3. The goal of providing assistance in adapting "traditional" instruction to a "non-traditional" environment, not making "bad" instruction "good," should be established early, and emphasized throughout.

4. The need and importance of faculty "ownership" of the distance delivered instruction should be highlighted. The instructional developer's job is to provide options and related rationale without wresting project control and decision making from the faculty member.

5. If a distance education training workshop is planned, it should be a "hands on" experience with faculty getting first hand experience using the technologies with which they will be teaching. Technical assistance should be available with advice offered in a supportive and jargon-free manner.

6. The opportunities, challenges, and difficulties faculty face in distance education settings, should be discussed, using a realistic appraisal of the system's strengths and weaknesses.

7. Practical strategies that can be immediately applied should be offered. These include managing the distance education experience, effective methods for tracking student participation, evaluating instructional effectiveness, and understanding the needs of distant learners.

8. Through contact with potential students and interaction with other faculty, distance delivery instructors should be assisted in developing an understanding and sensitivity to the social, cultural, educational, and economic backgrounds of the intended students. This understanding and appreciation will make for a

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more effective instructor and a more appreciative group of learners.

9. Examples are the primary means by which content is presented. Faculty may require assistance in finding and/or developing content-related examples of relevance to the distant learner.

10. Alternative roles that faculty, students, and support staff play in a distance education context should be explored. Many successful distance educators have found, for example, that their role expands beyond that of content provider. They become skilled facilitator's as well, drawing students out and encouraging full participation.

11. Patterns of communication that go well beyond the more traditional Teacher -Student and Student-Content interaction should be discussed. Explore with faculty the role of Student-Student interaction, including techniques for enhancing it.

12. Faculty networks of those involved in the distance delivery of instruction should be developed and nurtured on local, regional, national, and international levels. The on -going linkages they kindle and their potential for collective problem solving is invaluable.

13. Focus the majority of your faculty development time and resources on interested, enthusiastic, and committed faculty.

Realize that some faculty don't want to get involved with distance education. Rather than spend inordinate time and resources attempting to convince the intractable, focus on those who want to learn effective distance delivery techniques, or at least have an open mind to the opportunities that such techniques offer.

In addition, supporting the "early adopters" often leads to the interest and eventual participation of the initially skeptical.

14. Develop and nurture "mentoring" programs matching experienced distance education faculty with newcomers. While useful, shared content expertise in these mentoring experiences is not essential.

15. The relationship of distance education and the institutional reward structure, such as promotion, tenure, and publishing, must be dealt with by administrators in a proactive manner. It should be realized that, to be effective, distance education must be viewed as a critically and academically sound mode of teaching that is prominently reflected in the institutional reward structure.

There are many pathways leading to successful faculty development in a distance education context. All of these paths will have this in common: An informed understanding of specific programmatic goals, objectives, and needs that match strategies under consideration, realizing that successful faculty development programs evolve through a process that is methodical, flexible, and thoughtful.

The challenge is to match faculty development content and experiences to the distance education needs of the instructors, and ultimately, the students. The extent to which this is effectively accomplished will dictate the success or failure of the faculty development enterprise.

REFERENCES

(1) Gaff, J. G. Toward faculty renewal. San Francisco: Jossey-Bass, 1975, p 14.
(2) Willis, B. The converging fields of faculty development and consultation: A review of the literature. University of Alaska Instructional Telecommunications Consortium, 1983, P 3.
(3) Centra, J. A. Faculty development practices in U.S. colleges and universities. Princeton, N.J.: Educational Testing Service, 1976, P 1.

Hype and Reality in Interactive Media

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1. ABSTRACT

This paper examines the history, characteristics and rationale for Interactive Media, the need for a networked media computer, the hardware, software and human expertise required for Interactive Media production, the potential high growth market areas, and some obstacles to overcome before Interactive Media emerges in the mainstream.

2. INTRODUCTION

Over the past two years both business and educational publications have devoted an abundance of space to "Interactive Media" (IM). The increased awareness emerges from the technological capabilities of computers, television and other digital media such as CD ROMS, all of which are being augmented and "fused" into hybrids such as video computers, interactive television and desktop video. Every manufacturer worth their salt is readying an inexpensive machine with built-in CD ROM. In the late summer most Japanese consumer electronics companies introduced relatively low cost combiplayers that handle Laserdiscs, CD-I, CD-V and CD-Audio. Sony and other manufacturers of consumer electronics have also added built in fibre optic outs to their high end machines (eg. laser disc players) which allow connections with new DAT tape players and other devices.

John Barker, who writes a newsletter in England called Inside IT, says IM is "not going to go away. It's the natural evolution of computing, as it rises out of the primeval slime of letters and numbers on a flickering monochrome screen." While there is no clear cut choice as to whether the most successful hardware platforms for IM in the 1990s will come from the computer, television, or telecommunications industries, the computer industry has an edge because of its focus on ease of use of the human-machine interface. Currently, IM platforms are being produced by a combination of computer firms, software houses, video companies and new startups. Nevertheless, it is clear that education, training, business presentations and information retrieval in businesses, schools, and homes will take on a new dimension when integrated hardware is less expensive and when ease-to-use and powerful IM software is readily available.

According to the hype in the mass media IM is a collection of computer-centered technologies that give a user the capability to access and manipulate text, sounds, and images. Just a word processing programmes today enable users to integrate text and graphics, IM programs in the near future will enable users to access not only libraries of text documents but also storehouses of music, sound effects, speech, still images, animations, and movies. In addition, IM users will be able to manipulate a lexicon of materials and add their own material. Initially, users will see extensions of existing conventions such as interactive fiction, video notebooks, surrogate travel, and browsable movies, Gradually, producers and users will discover new ways to use IM. The objective of this paper is to separate fact from fiction.

3. HISTORY

In reality the presentation of multi-sensory information has been around for a long time. Ancient Greek Theatre as well as Chinese Theatre were early experiments in presenting multiple media-actors' motions, their dialog, and music--in a single form to enhance meaning.

Every review of interactive media pays homage to Vannevar Bush, a science advisor to United States President Truman, who in 1945 postulated a desk-size unit based on motion picture film that would give information workers rapid access to detailed information any time they needed it. Bush called this intelligent storage and retrieval system a Memex and he believed this technology would be extraordinarily useful to people who had to make quick decisions based on vast amounts of complex data.

Over the last two decades many educators and psychologists have focused on the hueristics of learning and to processes of concept formation concerned with simulating naturalistic modes of learning such as discovery learning, problem solving, case-studies and simulation. The ideas are based on the theories of Jean Piaget and Jerome S. Bruner. Their theories suggest that learning is based on cognitive structures and is permanently mediated through cognitive concepts. One model is "discovery learning" which is designed to simulate cognitive processes and to stimulate heuristic human thinking and problem solving. The theory suggests that learning tasks based on question and answer schemes do not offer enough freedom to exercise existing cognitive concepts and to develop new ones. Tasks which allow exploring and searching are better suited for discovery. Essential for this type of learning is the freedom of the learner to choose strategies and methods for handling an application.

Running parallel to these theories are the ideas of a maverick computer scientist, Ted Nelson, who coined the word "hypertext" in the early 1960's to describe a powerful, intuitive way to organize information. Hypertext, as the name suggest, is not a text or a method for processing words, but a collection of texts and other material available on a "media computer system". Hypertext applications give you the opportunity to combine different text pictures, graphics, statistical tables, and other information material in such a way that the learner can go from one document to another by using certain visual or audio cues in the first document which suggest that behind this clue there might be more information hidden.

The basic structure behind hypertext documents is that of a network consisting of semantic clues or nodes by which the different documents are connected. The form this structure might take includes:

-a simple linear sequence such as sequencing in traditional programmed instruction;

-a more complex form like that of a tree with branches similar to the hierarchical brances of a taxonomy; or

-a network with recursive paths like, for example Petri-nets where the nodes can be reached from different starting points and the branches have different values and meaning.

The objects of the network may be a document as a whole, then on an intermediate level parts of a document like pictures or paragraphs, and on a highly specialized level single terms or graphical elements.

Hypermedia or Interactive Media is a more recent concept derived from its precursos-computers, television, publishing and telecommunications. Computers and their peripherals contribute interactivity and the benefits of digital storage. Television adds the ability to motivate and communicate. Publishing lends formats that allow indexing, browsing and detailed information on demand. Finally, telecommunications contributes the ability to communicate or publish instantly over long distances.

Nick Arnett suggests a four layer model of hypermedia that results from this technological merger (Arnett, 1990):

-an audiovisual surface to offer overviews and motivation;

-an information navigation layer to find additional material;

-a content layer that is the actual information that's stored within the system; and

-a layer of creativity and publishing tools used to manipulate existing information or create new material for distribution.

The first layer is passive. The user is just viewing or browsing through information. Next is a more active layer where the user is grazing or hunting. Browsing occurs if the person is not sure what he or she is after and the term hunting is used if the person knows exactly what is desired, but does not necessarily know how to find it. The third layer in which the user is trying to acquire something is passive and requires some kind of storage system for data or ideas. The final layer where the creative tools are located is the most active layer. Here gathered materials may be synthesized and new material may be created.

The fact that these layers may be highly passive to highly active suggests that there is a need for two words to describe the person involved in the system. Passive people are caller viewers as in television viewer, but for active participants the word is user, as in computer user.

Information overload is the fundamental reason that is driving the demand for IM products. Computers are contributing to the information glut today, helping authors to generate and distribute increasing amounts of information in publications, databases, television programs, and so forth. The most successful IM products will help people deal with the overload, by giving them new ways to find, search, acquire, and use information (once again the four levels.)

3.1 INFORMATION LANDSCAPES

How do people present and represent knowledge so that others can understand it? The traditional method is a linear, narrative unfolding of sequential information through lectures and textbooks. Other methods use nonlinear, spatial layout of information such as diagrams and maps.

In trying to understand the IM's mode of presentation Fabrice Florin who works at Apple Computer Inc.'s Multimedia Lab (Florin, 1990) suggests that we should think of information landscapes which he thinks of as virtual towns or intellectual amusement parts. This analogy is intriguing and does help us to visualize many abstract concepts within a single metaphor. In the words of Florin:

> As you visit an information landscape, you can merely walk along pathways and look at roadside attractions, or you can choose from many different options. Some of the options take you on linear trails, which you experience passively from start to finish, as you would ride in a bus. Other activities give you local control-similar to driving a car. Maps can show you a birds eye view of the territory, and guides can take you on tours or give you more conversational assistance. The terrain on which the information landscape is built is the raw database, rich with varied materials, from which the 'visitor' can create new documents

> or exhibits. However, the information structure is what gives the landscape its distinctive form.

3.2 NAVIGATION

The process of navigation through a large information web is more of a puzzle than we might think because there are a number of aspects to the problem (Durlak, 1988):

-invisibility: People are used to print materials and often fail to consider how to translate print-derived wayfinding strategies into a format suitable for electronic text.

-No common perspective. It requires an interdisciplinary solution, but there are many players and researchers: librarians, human factor specialists, psychologists, publisher, educators and so on.

-Multiple processes: Involved are a number of different processes carried out at different levels of conscious activity including problem solving, problem recognition, search strategies and so on.

3.3 THE RATIONALE

Why develop interactive knowledge webs using a number of sensory media? We know that vision has an extremely wide bandwidth in terms of the amount of information it can pass to our brains. Hearing also has a fairly wide bandwidth. Combined, they can process a very large amount of information. However, as a medium, the printed word has a fairly narrow bandwidth because words must be processed or read in a serial fashion to communicate meaning. The same is true for speech.

By receiving input from various senses at once, however, the human brain is capable of creating meaning that is broader than that derived from a single serial medium. The creation of meaning is usually quicker as well.

More recently the term Interactive Media has come into use because it more accurately portrays the idea of multi-sensory learning through the appropriate use of scanned and video images, text animation, simulation, voice, music and hypertext software, all controlled by one computer with the ability to access the information nonsequentially.

The advantage of hypermedia from an educational or business viewpoint is that chances for a realistic interaction between the user and the subject are much greater. Users may follow their own cognitive strategies and may learn at their own pace. Their own personal heuristic continues to function. And they are not forced to suppress associative thinking and far fetched hypotheses.

The disadvantage of hypermedia is that user of hypertext applications may choose random or associative paths through the materials and be confounded by their own reasoning structures or the methodology of the subject. The author has no way to determine which method the user chooses. The only chance for the author to influence the decision of the user is to enrich the subject matter with didactic hints, tutorial suggestions (the value of certain relationships, comments, questions, tasks, evaluative remarks) or with the help of synthetic or human guides.

It is also not known whether IM systems improve the motivation of the users. Schulmeister suggests that IM presents a complex learning environment which at least offers the chance to behave "naturally" in two ways:

First; the application presents an environment which resembles the one a user encounters in a learning environment: a library, a desktop, books, pictures, and other material.

Second, users or learners may behave in this learning environment as they are accustomed to do normally. For instance to activate their individual learning strategies, to learn by heart or by testing hypotheses, to leaf through the package randomly or to search for certain symbolic keys, to browse in a linear fashion or to look for relations, to drill themselves or to identify themselves with important ideas or concepts.

While the degree of interactivity ranges depending on the learning objective, the users not only participate in the examination of the knowledge or information network, but also have the capability of creating customized presentations for their assignments or clients. This author believes that users have an authoring tool and a process that facilitates learning and persuasion in ways not achievable using traditional learning material such as lectures, books, chalk and blackboard illustrations, films and video tapes.

4.0 A NETWORKED MEDIA COMPUTER

Hugh Osborn, an independent IM designer and producer, states that what is needed on the hardware side is advances in media microchips and optical digital storage to create an all-digital, single-box, IM publishing platform. Osborn calls the platform the networked media computer (NMC). This all digital IM platform has several advantages over the hybrid system of today. The all-digital IM platform will be faster, cheaper, smaller, simpler to operate and capable of riding the hurricane of digital technology.

On the hypermedia creator side, this computer must have the minimum following characteristics.

Compressed audio. The intelligent use of audio completely alters the way a viewer perceives a program. The sense of time is

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controlled by the program instead of the user. However, large amounts of audio are required for sound to be more than a parlor trick, thus requiring compression of the data to at least 10 kilobytes per second for speech quality and even higher for music.

Mass storage. The requirement for audio leads to a need for optical storage approaching a billion characters. Currently a CD can store 650 megabytes.

Color graphics. Although there are superb programs in black and white, especially on the Macintosh, a shout goes up when pictures are presented in color. Most people don't use black and white TV sets if they can help it. The move will also be from 8 bit to 24 bit color with attendant needs for RAM, data compression and storage.

Motion. Animation, simulation and video needs 30 frames per second. This opens up access to huge stores of existing video footage, but also shoots storage requirement sky high, even with good compression algorithms.

Large amounts of RAM (random access memory). To handle the kinds of techniques that are required for user-friendly programmes, graphics and sound large working memory is needed. Currently, on a Macintosh a developer who is working in color needs eight megabytes and an IBM developer needs 16 megabytes and when the designer introduces three dimensional rendering the need for RAM will continue to accelerate. Consumer products are also reaching the point where they need at least 4 megabytes of memory to display the programs.

Communications. Since there is an increasing need for interactive media that incorporates groups (groupware), networking is also becoming a fundamental requirement. Communication, even if only at the modem level, is therefore a requirement.

Hyperauthoring. To produce programming inexpensively, hyperauthoring systems like Hyper Card must be available. As well, end-user authoring is also a requirement.

The development of INC's with these characteristics is occurring on two fronts: the computer industry (led by Apple, IBM, Intel, Microsoft, and NeXT with Commodore, Atari, DEC and others coming on strong) and the consumer electronic industry (Primarily, Sony, Phillips, NEC and Nintendo).

IBM's Info Windows with Touch Screen Display and Sony's View System have been popular in the business community for years. Intel's continued promise of affordable DVI (digital video interactive) standards might make the compression and playback of full-motion (30 frames-per-second) video a reality on the IBM PC.

The problem with Intel's compression scheme is that while the user might be able to play back compressed video on a personal computer, it takes a large, expensive computer to compress the data in the first place. So just as with records or CD's (and CD record production is coming down rapidly in price), consumers can play them, but not make them.

Apple, in contrast, stated publicly that its vision requires that the Macintosh be able to both make and play IM on the desktop. That is, users should have the option to be both consumers and producers. However, although I have seen some impressive demonstrations of what the Advanced Technology Group at Apple Computer, Inc. had up and running almost two years ago, they do not seem to be able to get the IM technology into the marketplace quickly enough or to have reasonable prices. Currently, however, they have realized that market share is important and maybe some of their IM technology will see daylight in 1991.

5. INTERACTIVE MEDIA PRODUCTION

Most people encounter IM presentations in boardrooms and sales rooms, schools and training centers, museums and shopping-mall kiosks. Very few, however, are in a position to invest the time and money necessary for creating truly professional IM project. IM production, especially if video is involved, is in the hands of the few who have access to advanced technology.

Besides needing a minimum of $50,000 worth of equipment (I take it for granted that the IM team is creating original music, Hi8 video, color graphics, and animation as needed) they must also have the ability to use a wide range of software for: authoring, audio input and editing, graphics, 2D and 3D graphics, animation, rendering, video digitizing and touchup; video editing, TV windowing, video In and Out, voice annotation, videodisc authoring and production, and maybe software for OCR, simulation, expert systems and/or intelligent agents.

From my experience, the team must have a producer/director, a professional designer with computer expertise, a music professional, a video professional, a software wizard and a technician. In addition, they need small egos because everyone on the team is going to cross over the boundaries of everyone else's expertise. Teamwork is the name of the game.

Although Hi Band video eight is making powerful inroads into Japan and Europe and the Video Toaster, which recently appeared for the Amiga, should make video presentations look better there are problems with time codes, inexpensive play back units, etc. Also, only commercial videodisc players have serial ports so that they can be easily controlled by a computer. It's important to note that the Super Famicon 16-bit Nintendo game machine that was released

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in Japan the end of November has a built in serial port.

6. POTENTIAL HIGH GROWTH MARKET AREAS

Over the past couple of years I got sick and tired of hearing about prototypes rather than finished projects. In 1990 several finished projects began to enter the marketplace and large business and mass media organizations began to set up organizational structure to take advantage of IM. There is no space in this paper to review those projects.

Nick Arnett in the September 1990 issue of Multimedia Computing & Presentations does a credible job of identifying four high-growth market areas that will be stimulated by IM technologies. The first two areas depend on IM's sensory impact and the second by IM's ability as the most effective medium for the message.

6.1 SENSORY IMPACT

These areas will be affected by IM's ability to "persuade, motivate, evoke emotion, indoctrinate and so forth." They include:

1. Training, education and instruction. Arnett suggests that these areas should be renamed performance enhancement because that redefines training, traditionally viewed as a cost center, as a revenue enhancer.

2. Sales and Marketing. Products are becoming more complex and sales are, therefore, a more difficult task.

6.2 AUDIOVISUAL SUBJECT MATTER

The next two areas that should show high growth take advantage of IM's ability to communicate audiovisual information that is difficult or impossible to understand only in text.

3. Documentation. IM systems can show how to do all sorts of things from "greening" your home (making it environmentally safe-a recent project my students completed) to servicing complex electronics.

4. Visualizations and simulations. "Using real-world audiovisual data or synthesized sounds and images, computers can take people places that they can't physically go to see new sights and hear new sounds." Of course, there is also hoopla about virtual realities, but that is another paper.

7. CONCLUSIONS

As Stefanac and Weiman point out in their article "Multimedia Is it Real?" IM is not just a buzzword, a set of products or an emerging market niche. IM "is the convergence of many new and some not so new, technologies that promise to work together in a new and meaningful ways." IM promises to enrich our computing environment and bring multisensory, nonlinear approaches to our work and play. It is expensive, demanding, and potentially rewarding.

Immediate problems that need solutions include:

1. Until optical read-write technology is affordable and reliable and real-time schemes for compression and decompression of video becomes feasible, the storage and transportation of IM documents will continue to present problems.

2. If you want to show a presentation to more than a few people, you're going to have to spend the money to transfer it to videotape and rent either an expensive video-projection unit or a 37 inch monitor..

3. Distribution of IM products is another problem. These products are not yet comfortably positioned in computer software stores, video rental outlets, bookstores or record stores. What is needed is a new kind of store where you could buy IM hardware and software in one convenient place.

4. Personal computer hardware and software makers only get a tiny percentage of their sales from IM technologies today and are aware that the field is critical to their future. At the same time consumer electronics firms also want to harness innovations in video and audio, setting them on a collision course with computer makers. Unless the computer companies are able to work in concert and develop common standards when the network media machine enters the marketplace it will be sold by Sony, Nintendo and NEC.

5. Computers are quite poor at searching large amounts of textual information. Even if optical character recognition, or some other form of technology came up with a quick, cheap and efficient way to get a significant amount of printed materials in libraries into digital format, there is no software that would make it useful and accessible currently.

6. Video is also beyond the sphere of current technology. Random access to any significant amount of video awaits not only digital storage techniques and a very expensive fiver optic infrastructure, but also the software tools to find and use video intelligently.

7. We are also being seduced to think that technically the computer can handle many different kinds of data, even kinesthetic data, using the highly publicized virtual reality technologies. However, practically it will be decades before large amounts of the world we live in are in the personal computer realm.

Nick Arnett suggests that this is the myth of the digital world. "The idea that everything can be digitized, now that computers can deal with text, graphics, photos, sounds, video and so forth."

While it is true that many kinds of data can be digitized, it is also true that many kinds of data will not be available in digital form. It is not clear that digitization adds value to many things, and can remove value such as the subtle tactile experience of curling up in a warm bed to read a book or a magazine.

8. Another problem, of course is copyright. If pieces of information can easily be "snipped" from electronic documents on a network and used in other material, who is the original owner and how should royalties be assigned. One way to cope with this problem is to system tag all material to keep track of who originated material so that prorated royalties can be assigned.

9. Many people have seen the Knowledge Navigator video-a simulated notebook size computer that talks and listens, fetches clips from video databases, and even schedules appointments for its owner. That vision is not currently possible with current central processing units, graphics and storage processing capabilities. And while Articulate Systems' Voice Navigator looks promising, voice-recognition technology for personal computers is still in its infancy.

On the other hand Thomas Malone of MIT's Sloan School of Management has devised a system called the Information Lens (R. Haavind, 1990), in which data is entered into a simple template. For example, a memo about a meeting has a template with fields for the meeting's time, place, and subject. Malone's Object Lens system does set up template for sorting information on many types of objects, such as tasks, companies, products, meetings, and people. The Information Lens is something like an information spreadsheet.

Malone's design makes it possible for intelligent software agents to rapidly search through and sort information. There can be a finding agent who searches for items on the network according to rules each user sets up or a filtering agent, which is in the user's computer and helps organize information and sort it according to priority. It is possible to keep track of the information pathways an individual uses and then to deduce a user's interests and needs. This means that the Object Lens could begin to act as a human reference librarian.

One last point. I spent the Japanese Thanksgiving weekend doing an environmental scan of the Akihabara discount electronics carnival district in Tokyo. Besides seeing Karaoke videodisc players, inexpensive multiple standard video tape recorders, players and television sets (let a hundred flowers blossom), VCR's with built-in satellite receivers to record DBS and two pound notebook computers, I bought a Sony Data Discman (30,000 which have been sold since it's release in July) which now has thirty titles in Japanese, a Sony TCD-D3 DAT Walkman and a My First Sony graphics computer for children. My congratulations to Sony for creativity, style and quality. I also tried to buy a Super Famicon (Nintendo 16-bit game machine), but had been officially released the day before and the stores were sold out or only had reserved items. The handwriting is on the wall.

BIBLIOGRAPHY

Nick Arnett, "Money Media Revisited", Multimedia and Presentations, 2, 3, January 15, 1990, 1+.

Nick Arnett, "The Myth of the Digital World, Multimedia Computing & Presentations, 2, 10, August 15, 1990, 1+

Jerome Durlak, "Singing in the brain", Minds in Motion, 1, Winter, 1988, 37-51.

Fabrice Florin "Information Landscapes", Learning with Interactive Media, edited by K. Hooper and S. Ambron, Microsoft Press, 1990, 27-50.

R. Haavind, "The Smart Toof for Information Overload Hypertext, Technology Review, November/December 1990, 43-50.

Hugh Osborn, "Media Computers, Motivation, and Informal Education: Gutenberg 2000?", Learning with Interactive Media, edited by K. Hooper and S. Ambron, Microsoft Press, 1990, 358-381.

R. Schulmeister, "Authoring Systems and Alternative", Wheels for the Mind Europe, 3, September, 1989, 3-10.

S. Stefanac and L. W iman, Mac World, April, 1990, 116-123.

USE OF MULTIMEDIA BACKBONE LAN

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1. ABSTRACT

Single-media (e.g., data) local area networks (LANs) have become widespread, and efforts at international standardization are already under way. Despite potential user needs, multimedia LANs that handle different types of data, including voice and video have do spread and caught in an unclear middle ground. Reflecting our work in this area to clarify requirements and needs, this paper gives an overview of the multimedia backbone LAN envisioned by Fujitsu, introduces an example of installation, and discusses possible problems.

2. BACKGROUND

As local area networks (LANs) have spread and the concepts and techniques behind them have attracted increasing attention, differences in environments have caused such LANs to develop to different degrees in different countries.

The first real LAN was developed in the United States, which has continued to lead in LAN development since the 1970s. Originally, LANs were constructed primarily to enable communication in a local distributed computer network. Two examples are Ethernet and Token-ring, which currently have major shares in the world market. They have become international standerds. With the spread of CATV in the U.S., broadband LANs have also come into widespread use.

In Japan, Nippon Telegraph and Telephone (NTT) has been active in promoting transmission using optical fiber cables. In this connection, research and development have proceeded in high-speed (30 Mbps or less) optical loop LANs using optical fiber cables. In the first half of the 1980s, optical loop LANs using time-division multiplexing sccess came into wide service in plants and laboratories where poor electromagnetic environments were common. One festure of the optical loop LAN is that it handles voice data, whereas LANs developed in the U.S. dealt only with computers.

As computer multivendorization continues in Japan, international-standard LANs, e.g., 10-Mbps Ethernet and 4- or 16-Mbps Token-ring, are taking over for optical loop LANs of 30Mbps or less. As computer use and distributed processing increase, the need is arising for a 100 Mbps or more backbone LAN. The development of such a LAN is being promoted based on optical loop LAN techniques.

Large high-speed (several 100 Mbps), opical loop LANs are already in practical use. From these have evolved multimedia backbone LANs combining high speed and multiple media, e.g., voice, image, and video.

Users would like to see these LANs provide the following:

(1) A reduced number of cables laid for each medium, e.g., data, voice, image, and video
(2) Expanded distances for each devices, e.g., LANs, PBXs, and TDM, and LAN interconnection
(3) Centralized management of transmission paths for each medium
(4) Robust networks resistant to for noise and accidents

Fujitsu's answer was the 400-Mbps high-speed optical loop multimedia highway link (MHLINK).

3. MHLINK OVERVIEW

Since its release in February 1987, about 50 MHLINKs have gone into operation in offices, plants, universities, and other institutions.
MHLINK functions were upgraded in 1990 to meet changes in the network environment.
The sections that follow give an overview of MHLINK design, system specifications, and system modes.

(1) Features

1) Multimedia integration

MHLINK, with its data, voice, image, and video interface, integrates media information into one optical fiber loop. Devices used for each medium are as follows:

Data: Ethernet, FDDI, TDM, peripheral input-output devices, ISDN terminals, V.24/V.28, V.35, X.21, and RS449 terminals
Voice: PBXs and telephones(ISDN)
Image: Faxes
Video: TV cameras and monitors

2) LAN interconnection

MHLINK connects LANs such as Ethernet (ISO 8802-3) and FDDI (ISO 9314) by a "learning bridge" enabling communication between them.
This reduces the load on individual LANs and extends distances, enabling a large-scale distributed processing system to be constructed.

3) Easy network operation and management

The use of dedicated network management enables centralized opreation and management for the entire MHLINK.

- Operation status, error information, performance information, and forth can be displayed, logged, and processed statistically.
  Traffic closed for each Ethernet can also be managed and the obtained information used to determine whether operation is being done under appropriate loads or whether additional workstations must be installed.

- The following information is collectively defined by software using the management device:
  - Connection conditions for individual devices
  - Network setup information, e.g., communication modes between devices

- Parts of the network can be extended or modified without stopping overall network operation.

4) Reliability

MHLINK's comprehensive automatic system recovery improves reliability.

- Dualized configuration of main units and optical fiber
- Prevention of errors in transmission paths by automatic Supervisory unit switching, loopback, and bypass
- Continuous monitoring of current and standby transmission paths status on the loop

(2) System configuration

Figure 1 shows the MHLINK system configuration. Table 1 lists system specifications. MHLINK consists of supervisory nodes (SNs), network service processors (NSPs), interface nodes (INs), and optical fiber cable.

The SN controls the entire MHLINK, generating clocks and data frames, monitaring transmisson paths, and controlling INs. To control the entire backbone LAN, the control unit is dualized. IF a failure occurs in the current unit, it is automatically switched to other unit. NSP connectd to the SN provides the man-machine interface for centralized management. NSP displays and logs operation and failure information, manages communication lines, and operates transmission paths and INs. INs provide interfacing with connected devices e.g., LANs, PBX, TDM, and cameras. An IN has eight slots, which hold as many boards as required to provide interfacing with the connected devices. Single-mode optical fiber enables high-speed 400-Mbps transmission. The optical fiber is dualized (current and standby). If a failure occurs in the current fiber, it is switched to the standby fiber. If both fibers fail, a loopback is automatically configured,

(3) Basic architecture

1) Media access

Both packet and circuit switching are used for multimedia communication. Packet switching is used for the high-speed transfer of packet information, e.g., Ethernet frame transfer. Circuit switching is used to transfer consecutive information, such as video broadcast and voice. A multimedia backbone LAN uses a media access method, e.g., the slotted-ring, enabling both packet and circuit switching.

2) Network topology

Multimedia communication modes include point-to-point, point-to-multipoint, and multipoint-to-multipoint (pear-to-pear).
Point-to-point is used for fixed connection between PBXs installed at different sites. Point-to-multipoint is used for video broadcasting. Multipoint-to-multipoint is used for interconnection between multiple Ethernets. A multimedia backbone LAN must support these modes efficiently.

3) Network capacity

The capacity required by a multimedia backbone LAN differs greatly with the LAN's use. For information such as data, image, and voice, the capacity will further depend on the size of the area covered. Video information, requires about 100 Mbps per line. If main purpose of the LAN's use video switching LAN capacity will be required, for example, a Giga order. Here we used 45 Mbps CODEC (Coder Decorder) for the video information. We estimated the capacity required for each medium as follows:

- Data or image: 100 to 200 Mbps
- Voice: 100 Mbps
- Video: 100 Mbps

Based on the above we concluded that a multimedia backbone LAN must have a capacity of at least 400 Mbps.

(4) Communication modes

Communication modes used between communication devices connected to MHLINK are detailed in the sections that follow:

1) Connection of FDDI and Ethernet

The following interconnections are possible:
- FDDI to FDDI
- Ethernet to Ethernet
- FDDI to Ethernet

High-speed communication between computers with high processing speed is provided by connection using FDDI. A deterioration of response time is prevented by connecting the host computer or a server in which data is concentrated by using FDDI (Figure 2).

2) PBX connction

MHLINK provides transmission paths between PBXs or between a PBX and remote unit (RU), enabling large-scale telephone network to be constructed.
An RU is a device used to install an expansion trunk in a remote area. The distance between the PBX and RU can be extended and the number of cables can be reduced (Figure 3).

3) Connection to video equipment

Video equipment having the NTSC interface can be connected, and MHLINK transmission paths can be used by allocating a 45-Mbps band to each line.
Video conferencing using point-to-point duplex and remote lecturing and video surveillance using point-to-multipoint one-way communication are enabled. (See Figure 4.)

4. EXAMPLE OF MHLINK APPLICATION

This section gives an example of how MHLINK is used as multimedia backbone LAN, considering customer requirements, system features, and the effects of installation.

1) Overview of Institute A

Institute A was established to provide projections of trends and international exchanges of information through the introduction of advanced technology related to equipment and information industries in Japan. The institute has a section for introducing high technology and new media, studareas and exhibits, areas for international exchange, and a service area with restaurants and sports facilities.

2) Customer needs

- Duplex and one-way transmission of video information can be made between a hall in a building or in-house CATV and the events area outside.

- PBX or RU is consolidated on each floor; optical cables in vertical ducts are shared with other media.

- Operation and management of facilities (performed by the host and workstations) can be conducted smoothly and efficiently by using a high-speed network.

3) System features

Figure 5 shows the system configuration of Institute A.

- MHLINK is installed for the vertical trunk lines for six floors, from the fourth floor to the second basement. Nodes (INs) are installed on each floor. Ethernet, RUs, and video equipment are connected to the nodes.
- The video equipment in the hall on the fourth floor and the in-house CATV on the first floor are connected to MHLINK. The video equipment in the events area is connected to the hall on the fourth floor via the 50-GHz radio system. These all go to make up the in-house video LAN.
- Telephones and facsimile equipment are connected to neighboring RUs.
- The host and workstations are connected to Ethernet to make up the following operation management systems:
  - Member management
  - Taking reservations for facilities (hall, conference rooms, exhibit halls)
  - Parking zone management
  - Energy management (electricity, water supply, hot-water supply, gas, air conditioning)
  - Account processing
  - AV software management

4) Installation effects

- An in-house video LAN linked with the 50-GHz radio system provides the following video services:
  - Bidirectional communication between the events area and the hall on the fourth floor
  - Unidirectional communication from the events area to the in-house CATV on the first floor
  - Unidirectional communication from the hall on the fourth floor to be the in-house CATV on the first floor

- In-house cables can be concentrated by connecting MHLINK and PBX-RU. Telephones and facsimile equipment on each floor can be connected from the RUs on the same floor; cables need not be laid to the PBX in the second basement.

- The following effects are obtained by connecting MHLINK and Ethernet.

  - Ethernet is on one floor. Cable space between floors can be reduced and the number of cables decreased when additional workstations are installed.

  - Because of Ethernet connections, workstations can be added without adding facilities for the host.

  - Resources, e.g., host databases and printers can be shared by workstations.

5. PROJECTED TREND

Despite potential user needs, integrated multimedia backbone LANs have yet to spread in Japan, perhaps, in part, because they do not fulfill user requirements for multimedia integration. Projected trends will involve the following:

1) Versatile video services

As stated before, MHLINK provides point-to-point and point-to-multipoint services.
The monitoring of information recorded by multiple cameras by one monitor and video switching may also be needed. To provide such services will require more advanced data communication techniques.

2) Flexible voice integration based on the environment

With MHLINK, telephones are connected to a PBX or RU linked to IN. This is effective for large plants or campuses, for example, which are spread out and occupy several buildings, because the distance can be extended and the number of cables decreased. A LAN in one building, however, has the disadvantage that much space is required to place INs and RUs on each floor.

Constructing a multimedia backbone LAN in a single building requires that telephones be connected using a minimum amount of space.

IVD-LAN (IEEE 802.9) is provided as an international LAN standard for data and voice.
It must be studied how or whether this standard is to be supported, given trends in IVD-LAN terminals.

3) High-speed data communication

MHLINK uses Ethernet and FDDI as high-speed connection interfaces for computers.
As computer performance improves and the number of supercomputers and high-speed workstations increases, a backbone LAN with a higher speed and larger capacity will be required to optimize performance.
It will also be necessary to connect high-speed peripheral input-output devices.

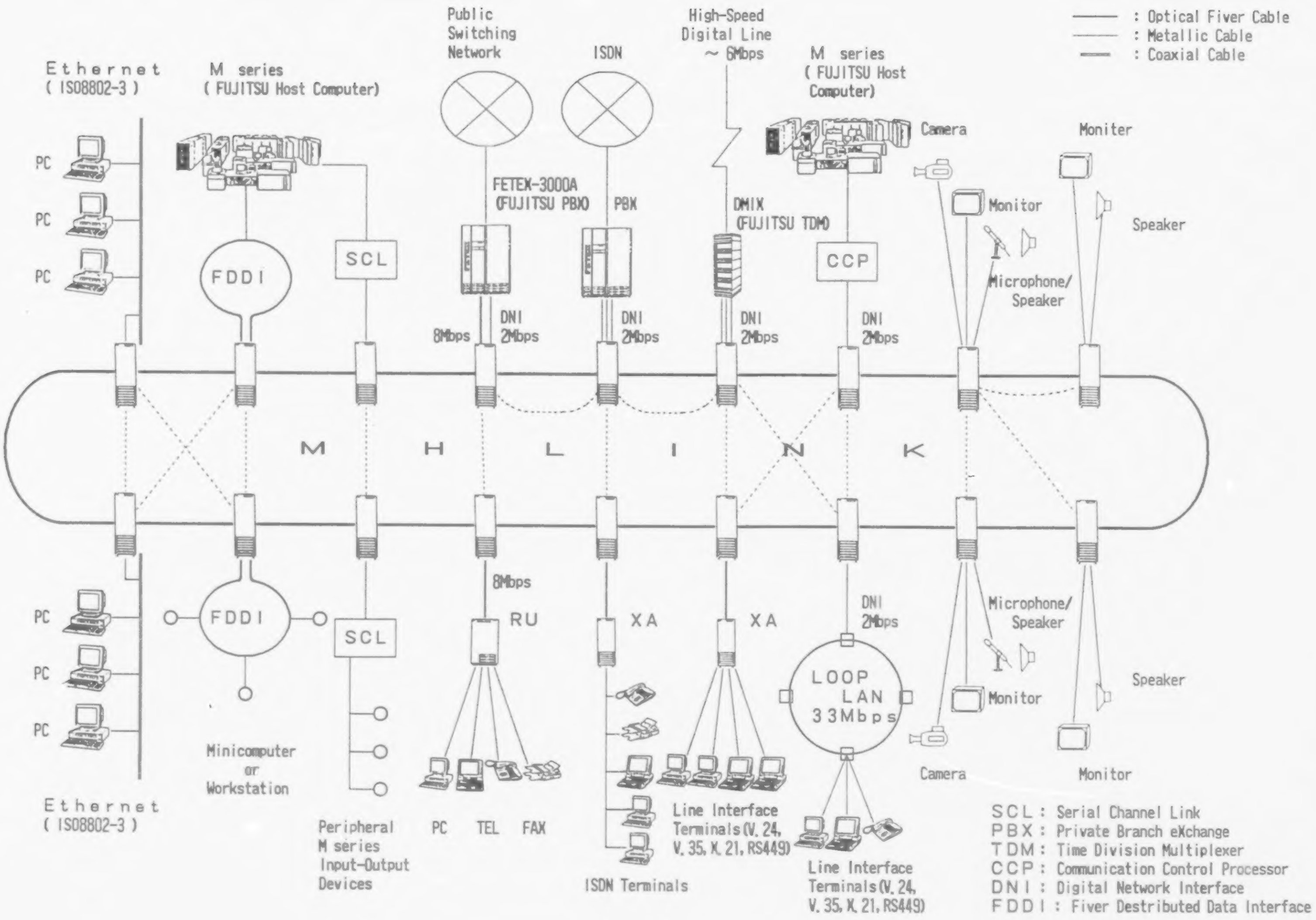

: Optical Fiver Cable
: Metallic Cable
: Coaxial Cable
Ethernet
(ISO8802-3)
M series
(FUJITSU Host Computer)
Public
Switching
Network
ISDN
High-Speed
Digital Line
~ 6Mbps
M series
(FUJITSU Host
Computer)
Camera
Moniter
PC
PC
PC
FETEX-3000A
(FUJITSU PBX)
PBX
DMIX
(FUJITSU TDM)
Monitor
Speaker
FDDI
SCL
CCP
Microphone/
Speaker
8Mbps
DNI
2Mbps
DNI
2Mbps
DNI
2Mbps
DNI
2Mbps
M H L I N K
8Mbps
PC
FDDI
SCL
RU
XA
XA
DNI
2Mbps
Microphone/
Speaker
PC
LOOP
LAN
33Mbps
Speaker
Monitor
PC
Minicomputer
or
Workstation
Camera
Monitor
Ethernet
(ISO8802-3)
Peripheral
M series
Input-Output
Devices
PC
TEL
FAX
ISDN Terminals
Line Interface
Terminals(V.24,
V.35, X.21, RS449)
Line Interface
Terminals(V.24,
V.35, X.21, RS449)
SCL : Serial Channel Link
PBX : Private Branch eXchange
TDM : Time Division Multiplexer
CCP : Communication Control Processor
DNI : Digital Network Interface
FDDI : Fiver Destributed Data Interface

Figure 1 MHLINK system configulation

Table 1 MHLINK specifications

Item	Specifications
Network topology	Dual loop
Components	SN, IN, NSP, and XA
Transmission speed	410Mbps
Media Access	Slotted ring
Communication	Point-to-point, point-to-multipoint, and multipoint-to-multipoint
Number of INs	64 (Maximum)
Node Span	10km (Maximum)
Connection interfaces	ISO8802-3 (IEEE802.3) :Ethernet
	ISO9314 :FDDI
	I.430 (ISDN) :ISDN terminals
	V.24/V.28, V.35, X.21, RS449 :Line interface terminals
	High-speed digital interface (2Mbps or 8Mbps)
	High-speed digital line (1.5Mbps or 6.3Mbps)
	NTSC (video interface)
Transmission cable	Single-mode optical fiver cable
RAS functions	Centralized network management using NSP
	Graphic display of network status on NSP
	Automatic ring reconfiguration (switching between current and standby lines, bypass or loopback)
	Duplexed SV

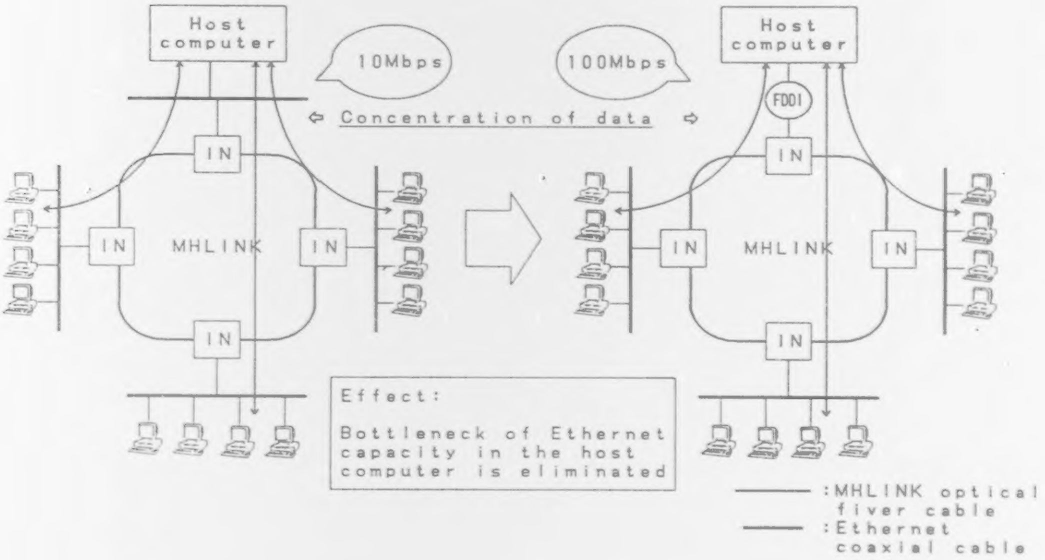
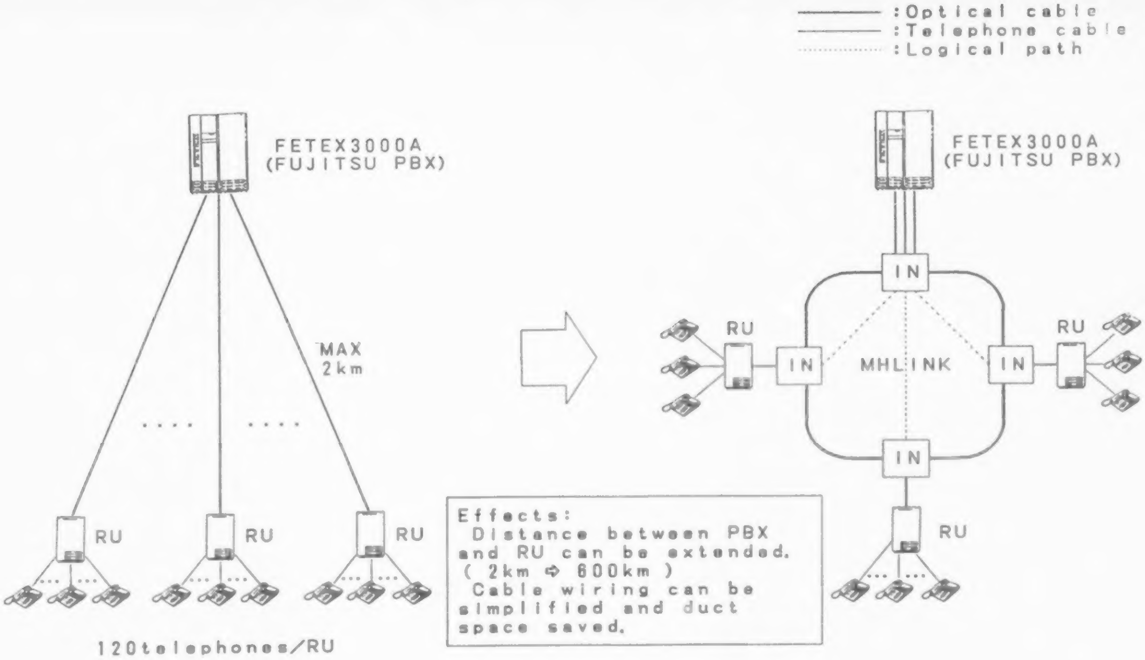
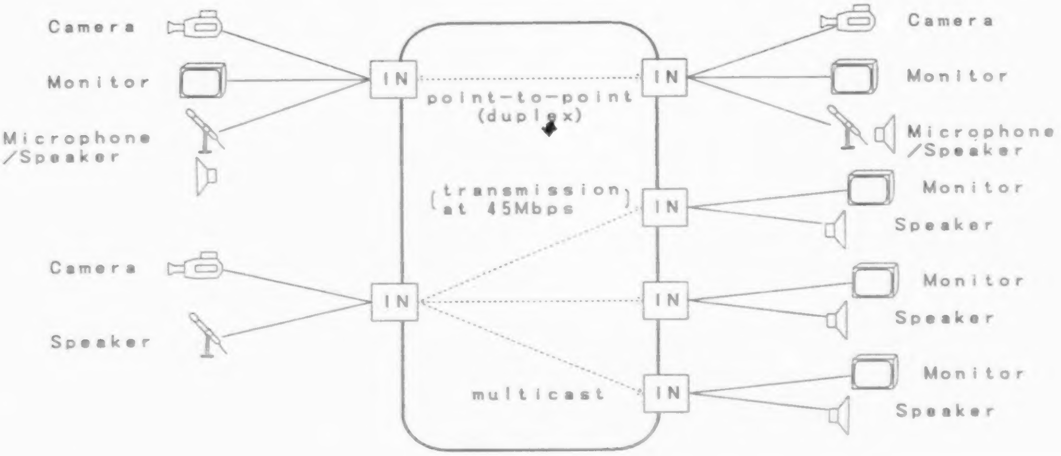

Host computer
10Mbps
100Mbps
Host computer
FDDI
⇦ Concentration of data ⇨
IN
IN
MHLINK
IN
IN
IN
IN
MHLINK
IN
IN
IN
Effect:
Bottleneck of Ethernet capacity in the host computer is eliminated
:MHLINK optical fiver cable
:Ethernet coaxial cable

Figure 2 High-speed communication by FDDI connection


:Optical cable
:Telephone cable
:Logical path
FETEX3000A
(FUJITSU PBX)
MAX
2km
RU
RU
RU
120telephones/RU
FETEX3000A
(FUJITSU PBX)
IN
RU
IN
MHLINK
IN
RU
IN
RU

Effects:
Distance between PBX and RU can be extended. (2km ⇨ 600km)
Cable wiring can be simplified and duct space saved.

Figure 3 PBX connection


Camera
Monitor
Microphone
/Speaker
Camera
Speaker
IN
IN
point-to-point
(duplex)
(transmission at 45Mbps)
multicast
IN
IN
IN
IN
Camera
Monitor
Microphone
/Speaker
Monitor
Speaker
Monitor
Speaker
Monitor
Speaker

Effects:

Duplex transmission of MHLINK enables video conferencing in a local area.

Multicasting(broadcasting) of MHLINK enable remote lecture

Figure 4 Connection to video equipment

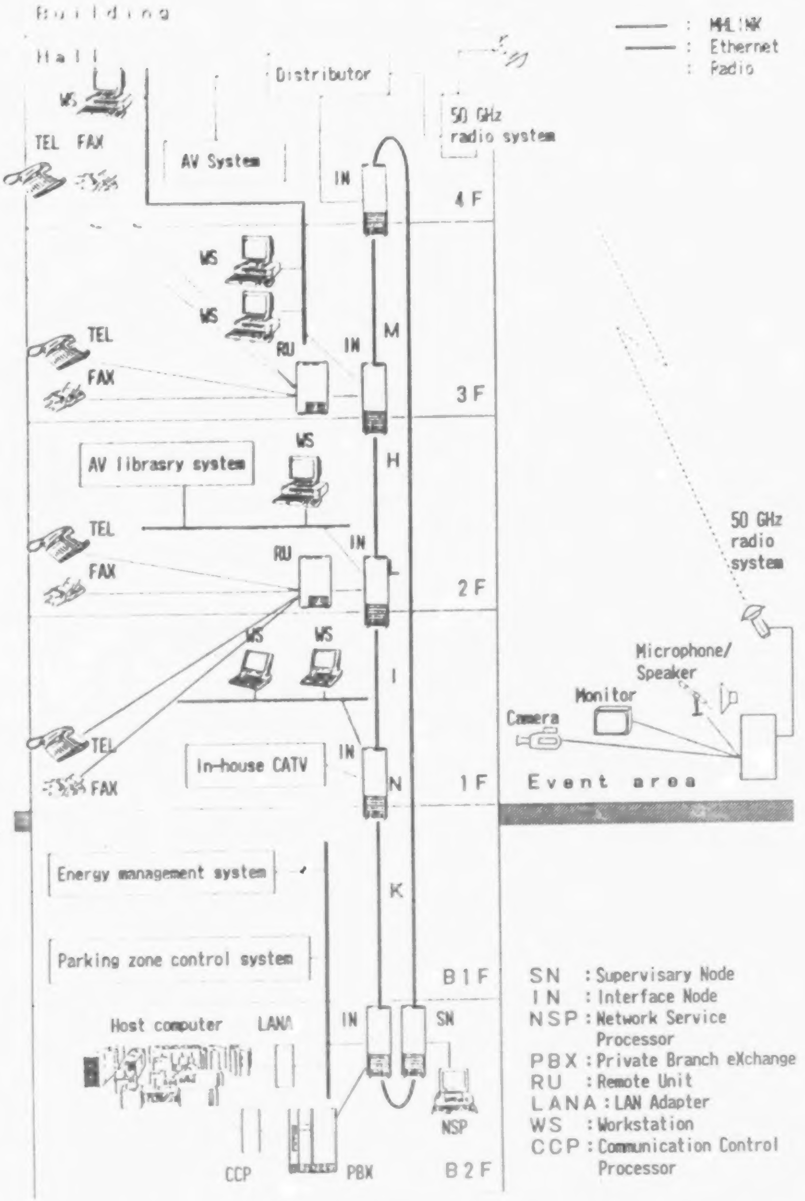

Building
Hall
: MHLINK
: Ethernet
: Radio
Distributor
WS
TEL FAX
AV System
IN
50 GHz radio system
4 F
WS
WS
M
TEL
RU
IN
FAX
3 F
WS
AV librasry system
H
TEL
IN
RU
FAX
L
2 F
50 GHz radio system
WS
WS
I
Microphone/ Speaker
Monitor
Camera
TEL
IN
In-house CATV
FAX
N
1 F
Event area
Energy management system
K
Parking zone control system
B1F
Host computer
LANA
IN
SN
NSP
CCP
PBX
B2F
SN : Supervisary Node
IN : Interface Node
NSP : Network Service Processor
PBX : Private Branch eXchange
RU : Remote Unit
LANA : LAN Adapter
WS : Workstation
CCP : Communication Control Processor

Figure 5 System configuration of Institute A

Flexibility: A Key Ingredient in the Pacific Video Mix

Joanne V. Tanner
Account Manager
COMSAT World Systems Division
Washington, D.C

January 15, 1991

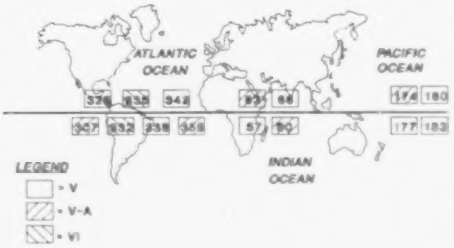
Abstract

This presentation provides an overview of the international satellite television services offered by COMSAT World Systems via the INTELSAT satellite system. Fifteen satellites are available for worldwide operation in a variety of beam connectivities, bandwidths, power levels and cost options. This presentation will examine the growth of television services in the Pacific region, new services for special events and new markets and opportunities that are well-suited to the efficiencies and economics offered by satellite communications.

1.0 Introduction

The first full-time international video lease was placed in service in 1982 in the Pacific Ocean Region (for Channel 9 Australia) between the United States and Australia. Since that time international television services, both full-time and occasional use, have seen dramatic growth throughout the INTELSAT system and specifically, in the Pacific Ocean region. Not only has their been an increase in the growth of television services for network news feeds and special events, but customer requirements have expanded and changed. This paper will review the options on the INTELSAT system for trans-Pacific television services reflecting a wide range of applications including the broadcast, cable, business television and video conferencing markets.

FIGURE 1 -- INTELSAT'S GLOBAL SATELLITE SYSTEM



2.0 INTELSAT Satellite Positions, System Roles and Comparative Information

The INTELSAT system provides built in flexibility for users tailored to particular satellites in each ocean region. These options include point-to-point or point-to-multi-point services, C-band, Ku-band or cross-strapped services, preemptible or non-preemptible options, simplex, half-duplex or full-duplex and a full range of price options.

The newest satellite series, INTELSAT VII, will be placed in the Pacific region in 1992 and 1993. These advanced satellites have higher power, including steerable spot (Ku-band) beams, and more capability than any satellite previously in the system.

FIGURE 2 - COMPARISON OF SATELLITES

	INTELSAT VI	INTELSAT VII	INTELSAT-K*
NUMBER OF BIRDS	5	5	1
TRANSPONDERS			
C-BAND:	38	25	N/A
Ku-BAND:	10	10	16
DESIGN LIFE	10 YRS.	11 YRS.	10 YRS.
HEMI & ZONE BEAMS**	31.0 dBW	33.0 dBW	N/A
GLOBAL BEAMS**	26.5 dBW	26.5 dBW	N/A
SPOT BEAMS**	44.7 dBW	44.5 dBW	47-50 dBW

* ATLANTIC OCEAN REGION SATELLITE
** DOWNLINK EIRP AT BEAM EDGE

3.0 COMSAT's Analog and Digital Television Services

Currently, network television and cable television customers primarily use analog television services for international television distribution. Other requirements, such as video conferencing and business TV, may find that a digital solution (using IBS or T1 circuits) provide a high-quality image that is suitable for your needs. The trade-offs are related to costs, picture quality, earth station sizes, bandwidth and power requirements. COMSAT can work with you to decide which is the optimal solution for your particular needs.

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3.1 Analog Television Services -- Occasional-Use and Lease Services

Occasional-Use Service

One of our most popular services, Occasional-Use television, offers the capability for scheduling satellite transmissions on a one-time or regularly scheduled basis. This service can fit all your international television needs -- news, sports, special events, video conferences and business television.

This services offers:

- global beam connectivity
- 24-hour per day, 365 days per year availability
- point-to-point or point-to-multi-point
- 10-minute minimum

Full-Time Lease Services

If your plans call for 24-hour connectivity for a short time (one week) or a long time (7 years), COMSAT can provide the service. We have a variety of lease terms available to fit your special requirements, from one week to one month to 2,5 or 7 years. This service offers:

- C-band, Ku-band or cross-strapped services
- global, hemispheric, zone or spot beam connectivities
- simplex or half-duplex connections
- bandwidth from 18 MHz to 72 MHz

3.2 International Business Service

COMSAT's International Business Service (IBS) is a completely digital private-line service that enables users to transmit and receive digital voice, video and data signals via satellite. This service offers:

- C-band, Ku-band or cross-strapped services
- point-to-point or point-to-multi-point service
- wide range of speeds from 64 Kbps to 768 Kbps and 1.544 Mbps, 2.048 Mbps and up to 8.448 Mbps or at fractional transponder capacities from 9 MHz to 72 MHz
- simplex, half-duplex and full-duplex transmission modes

4.0 Customer Applications

Meeting our customers needs is the most important thing we can do. COMSAT's flexible services attract a wide range of customers:

- Pacific broadcasters with full-time lease and occasional-use services to bring news, sports, entertainment programming and other information from the United States and Europe back home to their viewers.
- Cable Television customers using full-time leases and occasional-use services to distribute programming to hotels, apartment complexes and broadcasters.
- Facility Providers who lease space segment capacity and package an end-to-end services to include ground segment, interconnection and conversion services.
- Corporations who provide sales and training information via international videoconferencing seminars for their worldwide staffs.
- Corporations and businesses providing business television seminars for employees and customers worldwide.
- Customers requiring one-time connections for special events such as concert tours, sports events, etc.
- Programmers distributing syndicated materials to international markets.
- Companies providing international satellite news gathering services.

5.0 COMSAT's Engineering and Operations Services

24-hour Television Operations Center

COMSAT's TV Operations Center serves international television customers around the clock coordinating space segment availability with earth stations and foreign administrations. The COMSAT TV Operations Center operations as a 24-hour video communications hub for space segment ordering, troubleshooting, and scheduling fixed and transportable earth stations and implementation testing.

Customer Service Engineering

COMSAT's Customer Engineering staff is ready to assist customers better understand the world of international satellite communications and technology. Questions about bandwidth, power, stereo audio, associated audio and data channels can be answered here to solve your technical problems.

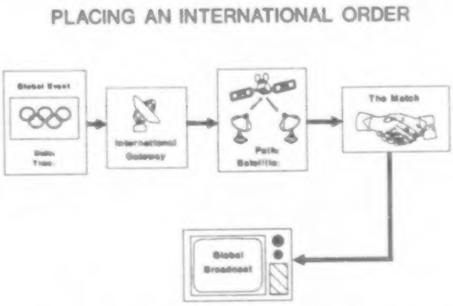
Customer Engineering provides guidance to U.S. earth station owners and providers on network standards and services, conducts earth station verification testing, provides on-site assistance, conducts feasibility analyses and has customer training classes on satellite technology for video, voice and data services.

6.0 COMSAT Television Scheduling Service (CTVS)

CTVS allows your personal computer on-line access to the COMSAT occasional-use and business television scheduling data base. CTVS provides instant information on earth station and satellite availability for the INTELSAT system. With CTVS you can quickly place orders for occasional service. CTVS also provides up-to-date information on earth station capabilities, satellite path configurations and international broadcast tariff rates.

7.0 How to Place An Order

The following outlines briefly the process for ordering or modifying an occasional-use television order. For lease services, please contact the on-site COMSAT representatives or call COMSAT Broadcast Services at 202-863-6796 or facsimile number 202-863-4121.



The International Order

Call the COMSAT TV Operations Center at (202) 863-6382. Our service coordinator will ask you pertinent details such as: the broadcast time, broadcast date, destination/origin of broadcast, the program category (e.g., News, videoconference, sporting event, special world event, program syndication, etc.) and the billable party. If the billable party does not have an account with COMSAT, we will take the necessary steps to establish an account.

The Domestic Order

The customer arranges the domestic links necessary to bring the program either from or to the international gateway. For a list of U.S. International Television Carriers, please call COMSAT at (202) 863-6796.

The Path, INTELSAT & Foreign Coordination

COMSAT's coordinator will suggest the transmission path, matching international satellites with earth station connectivity and access. When your requirements are recorded, your order is processed into the COMSAT automatic television system.

COMSAT contacts INTELSAT and orders the space segment. We advise the foreign authorized carrier of the service requirement. A request is then made for a matching order from the foreign end user.

At this point, you must advise your foreign counterpart to request a matching order from the foreign authorized carrier.

The Match

Once the order is matched (agreed to by all parties) and space segment is available, confirmation will be sent to the responsible parties. COMSAT will then send you a written confirmation by telex or facsimile.

8.0 Conclusion

Tremendous growth in the Pacific Ocean Region for television service will continue into the 1990's at a strong pace. COMSAT believes these services for all areas of television markets, broadcast TV, cable TV, video conferencing and business TV, will continue to grow and expand. The Pacific Region now accounts for 21% of the occasional-use TV traffic, 25% of the full-time TV lease services and 38% of the IBS services on the INTELSAT system. It is forecasted that these services will grow 5% of occasional-use TV, 18% for full-time TV and 10% for IBS services.

COMSAT's commitment to the Pacific Ocean Region involves many areas, including continued satellite availability, a commitment to the newest satellites, the INTELSAT VII's (planned to go the the Pacific region in 1992), increased Ku-band coverage, and higher satellite power which will enable greater use of the smaller and lower cost earth stations.

9.0 Contact Information

We welcome the opportunity to discuss your international satellite communications needs. Please contact use at:

Broadcast Services (all television inquiries):

Robert Twining, Director, Broadcast Services
202-863-6677

Joanne Tanner, Account Manager
202-863-6718

Voice and IBS Services
James Kasik, Director, Carrier Sales
202-863-6246

Our address and facsimile number is:

COMSAT World Systems
950 L'Enfant Plaza, S.W.
Washington, D.C. 20024
tel: 202-863-6000
fax: 202-488-3814 or 202-488-3819

GLOBAL NETWORKING VIA VSAT

A. Mahmoodshahi
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Crawfords Corner Road
Holmdel, New Jersey 07733

ABSTRACT

This paper presents the use of VSAT (Very Small Aperture Terminal) technology in the emerging Intelligent Global Network, a digital link between major commercial and financial centers, as well as between geographically disparate and little-developed areas. Already, technological advances in satellite transmission have led to low-cost, compact, integrated, earth stations with antennas measuring 1.8 meters or smaller. Today, VSATs have made available alternative services that could also be provided on carrier facilities. In "Global Networking via VSAT," VSAT services are presented as alternatives or backups to conventional terrestrial/satellite networks. VSAT networks can either replace or serve as backups for point-to-point, multidrop, and dial telephone lines and for one-way video and broadcasting services.

1. Introduction

This paper presents the use of VSAT (Very Small Aperture Terminal) technology in the emerging Intelligent Global Network. For end users, this Global Private Network provides a digital link connecting major commercial and financial centers as well as geographically separate and less developed areas around the world.

At present, the users of international communications have very little choice of facilities. This is true because in most cases the local administrations are interested in having users' traffic transmitted on their facilities. Since many of the administrations are government controlled or influenced, the tariff principles determine both the charges for and the definition of services offered on the facilities. Therefore, users are necessarily limited to the price and range of alternatives available.

However, advancements in satellite transmission technology have led to the development of low-cost, compact, integrated earth stations with antenna sizes of 1.8 meters or less. In turn, VSATs have made alternative services available which could also be provided on carrier facilities. Furthermore, VSAT technology has the added advantage of flexibility, cost effectiveness, and simplicity of maintenance and operation for both end users and carriers. In addition, the VSAT network promises a twofold benefit. First, it has the capability of meeting the future, rapidly changing, growth requirements of users in the international communication market. Second, it increases the feasibility of adding more circuits in metropolitan and rural areas, where adding terrestrial links would be prohibitively costly or practically impossible to install.

This paper describes VSAT technology services used as an alternative/backup to conventional terrestrial/satellite networks. VSAT may either replace or be used as a backup for point-to-point, multidrop, dial telephone lines and one-way video and broadcast services. In addition, this paper discusses the following:

- Overview of a VSAT network
- Advantages and disadvantages of the VSAT network
- Pros and cons of different Multiple Access schemes such as: Spread Spectrum Code Division Multiple Access (SSCDMA), Pure Aloha Multiple Access (PAMA), Slotted Aloha Multiple Access (SAMA), Demand Assigned Slotted Aloha Multiple Access (DASAMA)
- VSAT Applications
- Cost comparison of VSAT network vs. conventional terrestrial/satellite network
- VSAT future trends

The paper concludes that the VSAT network provides basic global facilities that will be exclusively dedicated to expediting international communications and networking. Such a single, private network would permit a multinational firm to connect its various domestic networks in a transparent, flexible and cost-effective manner. In addition, the VSAT network has the capability of meeting the future growth requirements of users in the international communications market. Also it insures the feasibility of adding circuits in metropolitan and rural areas, where adding terrestrial links is either costly or practically impossible. This technology permits service providers to offer a wider range of services to customers, with obvious advantages to both.

2. Overview of a VSAT Network

The basic VSAT network is an integrated satellite based packet switched network. These networks offer data, voice, and video transmission all in one package. This technology was pioneered in the 1980s by a few small companies. The current VSAT market is large and mature in North America. Figure 1 shows a typical VSAT network. VSAT networks predominantly use star network topologies in which all VSAT terminals communicate with the central hub. A hub is either private (dedicated) or shared. A private hub is more attractive to customers with heavy traffic and a desire to have a more secure network. A shared hub is more attractive to customers with moderate to low traffic, especially when the number of VSATs in a shared hub is fewer than 300.

A typical Transmission from these small terminals is in the form of data packets through a Contention Based/Time Division Multiple Access (CB/TDMA) satellite channel with a variable transmission delay of T_d second. This variable transmission delay depends on traffic; as the in-bound traffic increases so does the delay. The successful in-bound traffic is processed by the host and an

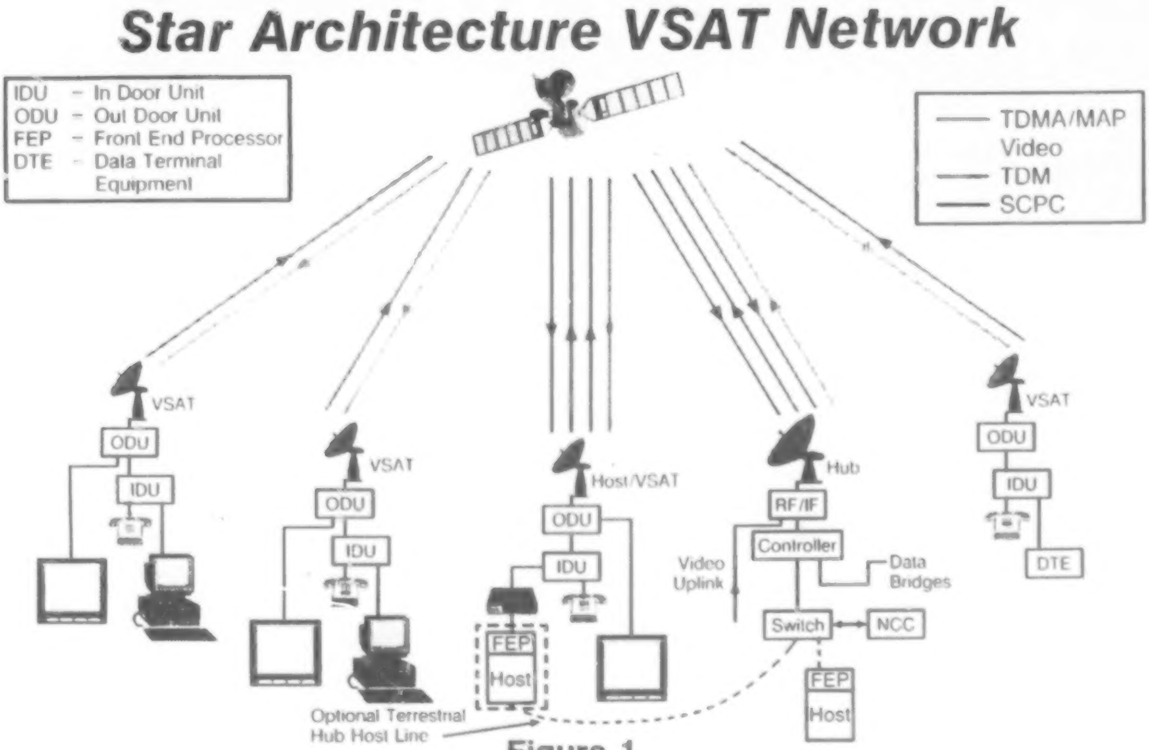

Figure 1

acknowledgment is transmitted back to the remote terminal via a broadcast Time Division Multiplexed (TDM) channel. In the event an in-bound packet is not received successfully a retransmission is required. The control of these in-bound packets are managed by a Multiple Access Protocol (MAP). These issues are discussed in further detail in the MAP comparison section. The out-bound traffic is via a broadcast TDM channel. The Time Division Multiplex (TDM) frame multiplexes the out-bound variable length data messages at the hub site and broadcasts them to all VSATs in the network.

A VSAT network is a synchronized network and the synchronization pattern is sent in every TDM frame for the synchronization of remote stations. The synchronization pattern also will provide the start of Time Division Multiple Access (TDMA) frames to all the terminals in the network for the in-bound traffic. A TDM frame starts with the synchronization field and variable length packets. Each packet in the TDM frame contains an address field that identifies the VSAT for which the message is intended. All VSATs in the network receive the TDM stream and, based on the address field, filter out messages not intended for their own use. This addressing scheme makes group addressing broadcast possible.

The in-bound transmission has a TDMA frame structure with contention protocol, such as slotted Aloha, which is shared by many remote terminals. Slotted Aloha contention protocols are the most typically use MAP for VSAT data networks. For Slotted Aloha protocols each frame is comprised of N number of uniform or variable slot sizes. The slot size depends on the packet size. The packet size from each remote terminal must be less than or equal to the slot size in the frame. Remote terminals must be synchronized so that they may only transmit at the beginning of each slot. The size of the slot and the number of slots/frame depends on the application. Overhead bits are added to a slot so that the data packets can be properly routed to their destinations. Note that the slot overhead is a significant part of the slot (up to 40 bytes); therefore selection of the slot size is important in order to have efficient in-bound throughput transmission.

2.1 Global VSAT Network

Government regulations have constrained the development of VSAT systems in most countries around the world. However, in recent years, European Postal Telegraph and Telephone (PTT) agencies started to think about deregulation of their communication systems. A recent example is British Telecom's deregulation of its telecommunication systems. At the present time, it appears that receive-only VSAT networks are growing faster than the interactive portion of VSAT networks. This is because more PTTs will allow operation of non-PTT terminal equipment in their countries for one way services applications.

Figure 2 illustrates the global VSAT network architecture. The existing U.S. domestic VSAT market and associated products are based on a star topology with a single hub earth station. For global networks, however, a star topology exists only in an overall network architecture, and they will functionally require multiple hubs. A minimum of three hubs are required for global networks application. Based on the capacity constraints of the international satellites and the spacecraft beam coverage variations, an overlapping coverage architecture would be deployed wherever applicable.

Global VSAT Network

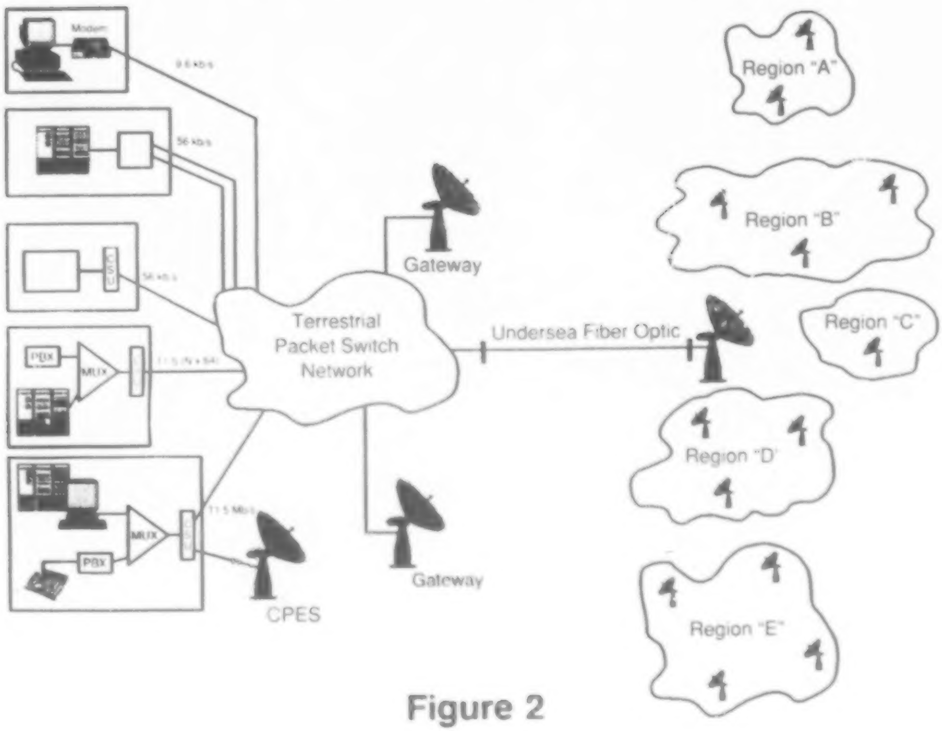

Figure 2

2.2 VSAT Advantages

Interactive VSAT networks are often appropriate for interaction-type data traffic that occurs in bursts and is periodic. These networks make efficient use of the capacity by having equal right of access to the transmission slots. This is in contrast with the all-or-nothing capacity of regular terrestrial dedicated lines. VSATs offer several unique characteristics that other services do not provide. The following are its advantages over terrestrial networks:

- Independent of node-to-host distance: A satellite network has wide geographical coverage and the cost of its transmission is independent from the distance between a host computer and the VSAT nodes. This has always been the main advantage of a satellite network over a terrestrial network. Note that the satellite network coverage area is as large as its prospective satellite footprint. Because of the large and expensive earth station antennas, however, conventional satellite networks were not very attractive to many customers. VSAT technology has overcame that problem by introducing smaller antennas (1.8 meters or less). Note that this became possible only when higher power satellites were introduced and launched.
- Low, predictable and fixed cost: Circuit cost in the VSAT network in general is less than that of circuits in the landline network. This is highly dependent on the following: application, geographical areas, and the size of the network (number of remote terminals). The cost of a U.S. domestic VSAT network/month/site can be as low as 300 dollars (U.S.). Generally, this amount includes equipment, maintenance, network management and other costs associated with the service. It excludes any local circuit charges, which may be necessary for terminal access. In addition, the cost of circuits in the VSAT network is fixed and predictable, whereas landline prices can be expected to rise over any period of time.
- Compactness and simplicity of installation and operation: A VSAT terminal is compact and easy to install. It consists of a 1.8 m antenna with an RF head mounted in the front of the antenna, and an In Door Unit (IDU) which performs all of the switching and protocol emulation.
- Integrated network (data, voice and video): VSAT networks provide integration and transmission of data (one- and two-way), voice and one-way video all under the same hardware and software in the remote location. They also allow for multiple protocols to be compatible with customer native host protocols.
- High flexibility and growth: One of the best advantages of VSAT networks is system flexibility. One or more terminals can be added, dropped or relocated on very short notice and a network can be reconfigured in

less than 15 minutes. This all can be performed without impact to any other nodes in the network.

- High availability and reliability: VSAT networks are highly reliable and the network availability can be greater than 99.5% of the time.

2.3 VSAT Disadvantages

Initial capital investment is one of the biggest disadvantages of the VSAT network. U.S. domestic remote earth station cost is between 10000-23000 (U.S.) dollars each, and the central hub earth station can cost as much as 1000000 (U.S.) dollars or more, including the RF/IF and switching system. In the international market these terminals will be higher in cost due to higher shipping costs, import duties fees and distributor markups. The hub cost is highly dependent on the network size. By amortizing the above cost over five to seven years, the monthly cost may be low, which makes it affordable to many customers. The second largest cost in the VSAT network is the space segment, which may be available only in discrete channel sizes. Deciding how much space segment to lease is important because leasing more than is necessary creates waste. On the other hand, leasing too little will not allow for accommodating network growth, and adding capacity later on in chunks will be even more expensive.

Another disadvantage of VSAT network is that there is no standard body to govern the VSAT network. Vendors' hardware and software are not compatible, which is an obvious problem to administrations and common carriers.

3. VSAT Multiple Access Protocols

The performance and efficiency of the VSAT network depends on several factors. These factors are antenna size, type of inbound Multiple Access Protocol (MAP), MAP flow control, controller and packet switch processors. The standard inbound channel of the VSAT Network is a shared TDMA channel with contention. Several multiple access protocols has been developed in the past decade. Among them are: Slotted Aloha Multiple Access (SAMA), Spread Spectrum Code Division Multiple Access (SSCDMA), Pure Aloha Multiple Access (PAMA) and Demand Assigned Multiple Access (DAMA). The SAMA has been used widely for Ku-band VSAT Networks and SSCDMA for C-band VSAT network. Based on the customer applications, one or more of these MAPs must be implemented. For example, SAMA with reservation is the best for a batch traffic type applications. For light interactive traffic the PAMA is the best one to deploy. SSCDMA is a proper choice for C-band networks with low data rate applications. Note that the VSAT network is a power limited network because of the use of very small antennas and low power transmitters. Therefore the satellite capacity usage is very inefficient whether spread spectrum or non-spread spectrum technology is employed. Table 1 compares all different MAPs.

Detailed discussions on satellite multiple access protocols can be found in many satellite and data communication textbooks, so only a brief introduction is given here. SSCDMA and SSCDMA with dual on-board modulation are presented in more detail here. Satellite channel sharing techniques are either fixed assigned, contention (random access) or reservation. Fixed assigned conventional TDMA is not well suited for bursty applications. Contention scheme protocols are more efficient for application involving bursty, low volume terminals. The use of a collision resolution procedure can result in higher throughput by clearing the channel when conflicts between transmissions occur.

Table 1

Multiple Access Protocols Comparison
Applicable to VSAT
Data Network

Protocols	Complexity	Stability	Delay	Max theoretical throughput %	Data Rate
TDMA	Medium	Good	High	75	High
PAMA	Low	Poor	Low	18	Medium
SAMA	Medium	Moderate	Low	36	Medium
DASAMA/TDMA	High	Good	High	70	High
PFDAMA	High	High	Low	70	High
SSCDMA	Medium	Moderate	Low	30	Low

3.1 SAMA (Slotted Aloha Multiple Access)

SAMA is an appropriate protocol for low to medium interactive two-way data services. In this scheme a frame is divided into a fixed number of slots (number of slots per frame depends on the packet size and the data rate of the in-bound channel). Each VSAT can transmit at any time; but must transmit only at the beginning of each slot. If more than one VSAT transmits into the same slot at the same time, collision occurs. Then the collision recovery algorithm must clear the conflict and request for retransmission. The probability that an individual packet suffers collision is:

$$P_c = 1 - e^{-G}$$

Where:

P_c = Probability of collision

G = The total rate of data presented to the network for transmission (offered load)

The throughput in SAMA can be calculated as follows:

$$S = Ge^{-G}$$

Where:

S = The total rate of data being transmitted between stations (throughput)

Note that MAP and local flow control must be implemented to avoid long delays and to improve the throughput and response time.

3.2 PAMA (Pure Aloha Multiple Access)

This is a simplified version of SAMA. In this scheme there are no slots and any VSAT can transmit at any time. If more than one VSAT transmits at the same time, a collision will occur typically on only part of the transmission, however, the entire transmission must be resent. The collision recovery algorithm must clear the conflict. The probability that an individual packet suffers collision is:

$$P_c = 1 - e^{-2G}$$

The throughput in PAMA can be calculated as follows:

$$S = Ge^{-2G}$$

This scheme is less complex and has half the efficiency of SAMA. The throughput supported by PAMA is competitive with other protocols for short messages, such as point-of-sale. This is partly because of the minimal overhead required by PAMA.

3.3 DASAMA (Demand Assigned Slotted Aloha Multiple Access)

In this controlled access scheme, a VSAT station requests slot through the central location or hub. Once the slots are granted the VSAT station has contention-free slots during its transmission. It can take up to one frame before slots can be allocated to the VSAT due to the round trip satellite delay. This access scheme is more efficient than SAMA for heavy data traffic that may originate from some terminals in the network. The reservation channel can be TDMA or slotted Aloha. If a slotted Aloha channel is used to request reserved slots, the protocol can no longer be considered contention-free.

3.4 PFDAMA (Pure Frequency Demand Assigned Multiple Access)

This multiple access scheme is primarily used for voice applications. It provides individual access of rural telephones to the urban terrestrial circuit switched network, and point-to-point access over single satellite hop in a mesh topology. In this technology, connections are made on demand. Voice channel can be compressed to as low as 4.8 Kbps in order to minimize the power and bandwidth utilization on the space segment. The Network Control system at the hub provides the central switching for the network and directs the satellite Demand Assigned Multiple Access (DAMA) functions to all VSATs. In a DAMA environment any VSAT can call any other VSAT and establish a session. The session can be either voice or data. When the session is finished, the call originator will terminate the link, and the frequency becomes available for other users through the central switching system. The central switching system coordinates all the calls for the network.

3.5 SSCDMA (Spread Spectrum Code Division Multiple Access)

This scheme is used primarily for C-band VSAT networks. There are two major problems associated with the use of VSATs in the C-band. The first one is the lack of directivity of 4-foot dish antenna with a beamwidth of 5 degrees. This results in the reception of signals from adjacent satellites (2° domestic or 3° international apart), as well as from the desired satellite. The second problem with the use of VSATs is that of limited received signal power due to its small antenna. These problems can be eased by using spread spectrum technology. In the following section SSCDMA is described in more detail (1). This is because the C-band is a dominated satellite frequency for most part of the world under Intelsat coverage.

3.5.1 SSCDMA Signal-to-Noise Ratio

In SSCDMA, all users operate at the same nominal frequency and use the entire allocated bandwidth simultaneously. The important feature of CDMA is that unlike FDMA and TDMA, minimal dynamic coordination is needed between the various transmitters in the system. For Code-Division Multiple Access systems, large sets of sequences with low off-peak autocorrelation (side lobes) and cross-correlation are required. There are a number of ways to generate code sequences with low cross-correlation. Three such methods use maximal-length sequences (M-sequence), Gold sequences or Kasami sequences.

A CDMA system with poor code selection can be subject to severe interference from adjacent satellites or even from other users in the desired system. There are a number of advantages using Kasami sequences rather than M-sequences. Necessary coordination with adjacent satellites is much easier to achieve with a large set of Kasami sequences featuring low cross-correlation than with M-sequences. In addition, more VSATs can operate simultaneously using Kasami sequences rather than M-sequences. The following section describes the relationship between cross-correlation and signal to noise ratio.

Relationship Between Cross-Correlation and Signal-to-Noise Ratio: the cross-correlation value between the two Kasami sequences has direct impact on the signal to noise ratios. This relation can be shown by the following equation (2,3)

$$SNR_i = \frac{1}{\left[\frac{1}{(6N^3)} \sum_{k=1}^{k=K} r_{k,i} + \frac{N_o}{2E}\right]^{1/2}}$$

Where:

SNR_i = Signal to Noise Ratio for the user

E = Energy per information bit

N_o = Single sided noise density

K = Number of users

N = Length of the codes

$r_{k,i}$ = Function of cross-correlation values between the user k and i

3.5.2 Correlation Parameters for Binary Sequences

The peak periodic cross-correlation and odd cross-correlation function for sequences u and v is given respectively by (4):

$$\zeta_{u,v}(l) = C_{u,v}(l) + C_{u,v}(l-N) \qquad 0 \le l \le N-1$$

$$\dot{\zeta}_{u,v}(l) = C_{u,v}(l) - C_{u,v}(l-N) \qquad 0 \le l \le N-1$$

Where:

$\zeta_{u,v(l)}$ = Peak periodic cross-correlation

$\dot{\zeta}_{u,v(l)}$ = Odd cross-correlation

$u = a^{(k)}$ = u sequence represents the k user in the network

$v = a^{(i)}$ = v sequence represents the i user in the network

$C_{u,v}(l)$ = Cross-correlation between sequence u and phase l of sequence v

$C_{u,v}(l-N)$ = Cross-correlation between sequence u and phase l-N of sequence v

$$C_{u,v}(l) = \sum_{j=0}^{j=N-l-1} u_j v_{j+l} \qquad 0 \le l \le N-1$$

$$C_{u,v}(l) = \sum_{j=0}^{j=N-l+1} u_{j-l} v_j \qquad l-N \le l < 0$$

$$C_{u,v}(l) = 0 \qquad l \ge N$$

An important issue involves choosing codes to provide acceptable signal-to-interference ratio performance. The choice depends, primarily, on the type of application and the number of users. In asynchronous systems remote transmitters operate independently and codes from different remotes overlap randomly at the hub receiver. Good codes for such an asynchronous system should be close to orthogonal for all relative phase shifts. This requirement is equivalent to requiring low cross correlation between codes for all phase shifts. Kasami codes meet this latter requirement. In order to check the performance of these codes, a computer program was written and used to compute the interference between users when such good codes are employed. This computation was done for codes of length 255. The resulting effective user signal-to-interference ratios were within a few tenths of a dB to values predicted by the following equation (5):

$$\left(\frac{E_b}{N_o}\right)_K = \left(\left(\frac{N_o}{E_B}\right)_1 + \frac{2}{3}\left(\frac{K-1}{M}\right)\right)^{-1}$$

Where:

$\left(\frac{E_b}{N_o}\right)_1 = \frac{\text{energy per data bit}}{\text{single-sided noise density}}$ for a single user, i.e. only one user on the system.

$\left(\frac{E_b}{N_o}\right)_k = \frac{\text{energy per data bit}}{\text{single-sided noise density}}$ for a single user with K users operating simultaneously.

K = The total number of system users.

M = The number of chips/bit.

This equation has been used in the analysis to evaluate the signal-to-interference ratios as a result of interference from other users operating simultaneously in the same channel. Because there are approximately 33,000 Kasami codes of length 1023, it is likely that a practical number of good codes are available.

The SSCDMA should perform satisfactorily at the low bit rates transmitted from the remote to hub. This performance will degrade if the adjacent satellite uses a similar SSCDMA scheme with a large number of carriers of high cross correlation codes. There are, however, several engineering means to avoid the interference, including choosing codes with low correlation or by offsetting the carrier center frequency.

3.6 SSCDMA with Dual On Board Modulation

The new generation of VSATs can look into the use of SSCDMA in conjunction with dual onboard processing modulation. This technology reduces the effect of this source of interference and improves the satellite capacity. The SSCDMA with onboard processing of dual modulation suggested using SSCDMA in the uplink from multiple VSATs to the satellite, and using non-spread spectrum such as TDM for the down link or from satellite to hub. The change of modulation must be performed on the satellite. Note that the Ku-band SSCDMA is limited by the downlink carrier to noise ratio. To improve this ratio, which is influenced significantly by the co-channel interference that the users present to one another, down link modulation must be change from SSCDMA to TDM onboard the satellite. Since the satellite demodulates all of the user's signals, the synchronization required in the TDM system can be done at the satellite.

4. VSAT Applications and the Proper MAP

There are basically six categories of applications for VSAT networks. Note that the application has direct impact on selecting the proper MAP. These applications are as follows:

- Interactive Data: Two-way interactive data provides an immediate and effective way for customers to manage provisioning problems for widely dispersed, sometimes remote, multiple locations. The interactive data from bank transactions and Automatic Teller Machines (ATM) have low arrival rate and typically consist of a single packet of about 150 bytes for in- and out-bound. Pure Aloha/slotted Aloha are best suited for this type of application. With this specification, large numbers of VSATs can share the same in-bound channel. Interactive data represents less than 20% of VSAT applications.
- File transfer: Almost all retail customers have a need for this application, which is best served by slotted Aloha with reservation or Single Channel Per Carrier (SCPC).
- Inquiry/Response: Inquiry/response applications such as those used for airline and hotel reservations, are the largest application for VSAT networks. In this type of application, the in-bound traffic is a short message of length less than 100 bytes and the outbound traffic of greater than 500 bytes. Slotted Aloha multiple access is best to meet the traffic demands of this application.
- Data Broadcast: Customers of one-way data broadcast are often stock ticker-tape, news, and financial institutions. This service provides an immediate, efficient means to disseminate generic headquarters information to all company locations. The broadcast service is distributed from the central hub location to all VSATs in the network via a TDM channel.
- One Way Video: Users of this services are often network TV distributors and corporations that provide training, sales and marketing seminars to their employees at multiple remote locations. In the international market this may be limited on Intelsat satellites due to the larger VSAT antennas which would be required.
- Voice: This is the largest application for VSAT networks in the international market especially in developing countries. The best protocol for voice is pure frequency DAMA. This is typically an expensive protocol and it will only proves in economically if the voice traffic is heavy. For applications with a low arrival rate of voice traffic, slotted Aloha with reservation may be better and less expensive.

In the reality of the marketplace, VSAT networks must be able to provide all of the above applications in a single product.

5. Economics Comparison of VSAT vs. Terrestrial Networks

The telecommunications industry has accepted VSATs as an economically attractive means of data transmission for corporate networks throughout the U.S.. VSAT transmission is meeting corporate communication requirements for low-speed point-to-multi-point data networks with low-cost, roof-mounted earth stations on customer premises. Sharma (6) has done a cost-comparison analysis for VSAT networks and analog terrestrial multi-drop leased line networks. Based on her framework, this section analyzes the economics of virtual circuit services offered through VSAT networks. These analyses can be applied to the international network and compared with international terrestrial alternatives. Of course use of proper international tariff is required.

In a generic terrestrial system, the network consists of nodes, located where there are clusters of users. These nodes are interconnected by trunk lines. Users are connected to the nearest node through a tail end line. The broadcast data stream from the host is past between nodes and is then replicated on to each of the tail end lines. The capacity of both the trunk lines and tail end lines is the same because all lines carry the same information. Note that the cost of terrestrial lines is proportional to the throughput of the line and its length. At one extreme, where there are no clusters of users, one trunk line will be required for each user, at the other extreme, only a tail end circuit will be required for each user. Consequently, the cost in both cases is proportional to the number of users but rises steeply when they are geographically dispersed. Figure 3 shows the terrestrial cost vs. satellite cost for broadcast application.

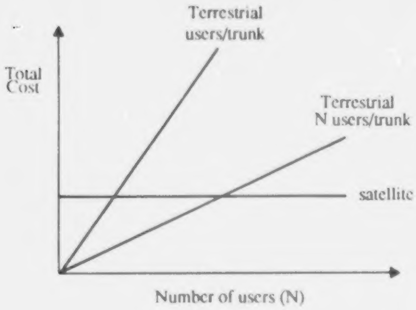

Figure 3

For interactive applications, which individual users setup a communication link with the central system (Host), then it is no longer necessary to provide trunk lines and tail end lines which can carry the full aggregate traffic. In this case, terrestrial circuit cost is much higher than satellite circuit for users that are geographically dispersed and it may be lower for users that are geographically local. Figure 4 shows this comparison.

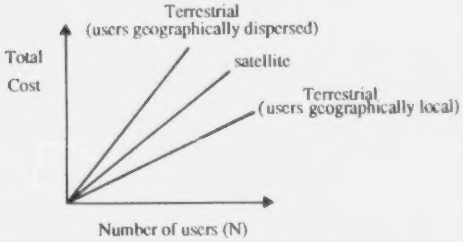

Figure 4

5.1 VSAT Network Circuit Cost/Month/Circuit

This section develops a VSAT network cost model. There are at least three VSAT network architectures that can be used to develop a VSAT cost model. These architectures are as follows: VSATs at each remote location, VSATs at selected sites and other remote locations connected to the VSATs via multi-drop lines, and VSAT in a central site and other sites are linked to the station through a terrestrial broadcast multiple access packet radio network. This study only focuses on the first approach where VSATs are located at every remote site.

There are three major components in a VSAT Network Cost model: remote earth station cost, hub cost and space segment cost. In addition there are other cost elements that need to be added to the VSAT network such as installation, licensing, operation and maintenance and spare equipment. Given these various considerations the cost model for the VSAT network is as follows:

$$C = \frac{(V + \frac{H}{N}) \times F + \frac{(n \times TI) + (K \times TO)}{N} + OM}{n_c}$$

where:

C = Cost/VSAT/Month/Circuit

V = Installed VSAT Cost

H = Installed Hub Cost

N = Number of VSATs/Network

F = Capitalization factor

TI= Space segment cost/month for an in-bound carrier

n = # of in-bound channels to support N VSATs = INT $(\frac{N}{i} + 1)$ where i is the number of VSATs per in-bound channels

TO= Space segment cost/month for an out-bound channel

OM= Operation and Maintenance Cost/VSAT/Month/Circuit

n_c= Number of circuits/VSAT

K = # of outbound channels to support N VSATs = INT $(\frac{N}{o} + 1)$ where o is the number of VSATs per outbound

Figure 5 demonstrates that the monthly cost of a circuit per VSAT is a function of the number of VSATs that can be supported per in-bound channel and also the total number of VSATs that can be supported per hub. As the number of VSATs per in-bound channel increases, the monthly cost of a circuit per VSAT decreases. The monthly cost of a circuit per VSAT decreases as the number of VSATs per hub increases. The average cost of a circuit per U.S. domestic VSAT varies from 300 dollars to 1700 dollars. The VSAT network is not cost-effective if the number of VSATs per network is less than 300 for a dedicated hub. For a shared hub, the total number of VSAT for all customers sharing a hub must be greater than 300.

6. VSAT Future Trends

VSAT technology must be enhanced to meet the growing needs of customers. Some of these improvements have already been started, but more work needs to be done to implement them fully. The following is a list of future trends in VSAT technology:

- Dynamic on loading/off loading of the in-bound channel. This technology improves

U.S. Domestic VSATs Network Cost/Month/Circuit

N := 50,100...2000 Number of VSAT per Hub
V := 12000 Installed U.S. Domestic VSAT Cost
H := 2000000 Installed U.S. Domestic Hub Cost
F := .0212 Capitalization Factor
TI := 1600 64 Kbps Inbound Ku-Band Transponder Cost Per Month

TO = 14000 512 Kbps Outbound Ku Band Transponder Cost Per Month
I = 5,10....50 Number of VSATs Can Be Supported Per 64 Kbps Inbound
O = 300,600,1500 Number of VSATs Can Be Supported Per 512 Kbps Outbound
OM = 80 Operation and Maintenance Cost Per VSAT Per Month
nc = 1 Number of Circuit Per VSAT

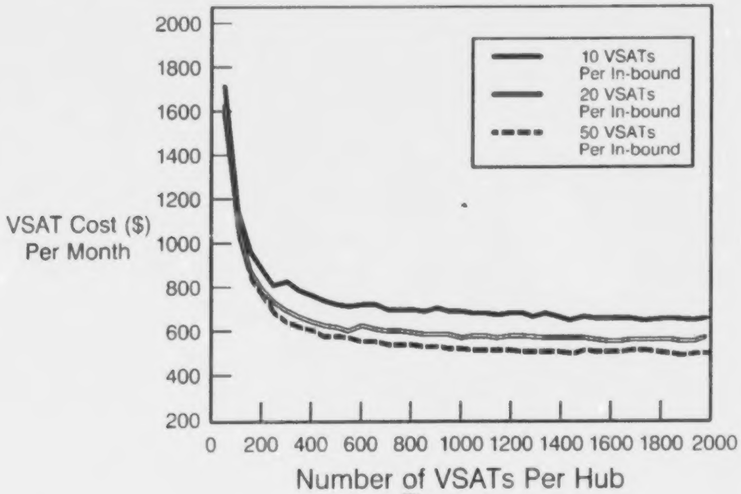

Figure 5

the VSAT throughput and thus improves the VSAT response time. It also reduces the VSAT cost per month by utilizing the in-bound channels in the network more efficiently.

- New communication satellites to provide higher power HPAs (High Power Amplifier), use of spot beams and scanning beams, on-board processing and intersatellite links. These features provide higher capacity VSAT networks with lower cost earth station and greater flexibility of network access. The use of intersatellite links may provide direct connectivity and integration into other networks without requiring terrestrial connections.
- The emerging USAT (Ultra Small Aperture Terminal) network technology uses a reduced size antenna at the remote earth station (.6 meters). This technology not only reduces the cost of the remote earth stations, but also facilitates the installation of such stations. However, it results in a decrease in antenna gain. Without High Power Amplifier (HPA) devices in the satellite to compensate for the lost gain, the power per bandwidth must increase, which, in turn, increases the cost of the VSAT circuit per month.
- In-bound SSCDMA Ku-band in conjunction with onboard satellite dual modulation processing as discussed in section 3.6. This technology provides two advantages. First, it makes it possible for the VSAT network to operate in an interference-limited satellite environment. Second, this technology reduces the effect of co-channel interference by demodulating SSCDMA carriers on the satellite and modulating it again using TDM modulation for the downlink.
- Local Area Network (LAN)-to-LAN Connectivity.
- LAN-to-Wide-Area Network crossbridging.
- Distributed (Mesh) VSAT Network: A mesh network is very attractive for customers with a distributed host network and/or heavy voice traffic between each VSATs.
- High-speed data and image delivery.
- ISDN over the VSAT Network.
- Highly reliable low-rate voice transmission (4.8 Kbps or lower).
- High quality compressed video.
- Improvement on C-band VSAT, especially in the RF head and Solid State Power Amplifier (SSPA) size.
- Improved design on remote antenna mounting to reduce the cost of installation.
- Value added services such as Electronic Mail.

7. Conclusion

In conclusion, VSAT networks satisfy the ever-increasing customer requirements for enhanced international communication and networking. VSAT networks provide basic low capacity global services that will be dedicated to expediting international communications and networking. A single private VSAT network permits multinational firms to connect various domestic networks in a transparent, flexible and cost-effective manner while providing administrations around the world to a new service offering that increases traffic and leads to a greater demand. In addition, VSAT networks have the capability of meeting the future growth requirements of users in the international communications market. Also, it insures the feasibility of adding circuits in metropolitan and rural areas, where adding terrestrial links can be costly or practically impossible. This technology permits service providers to offer a wider range of services to customers, with obvious advantages to both.

VSAT technology and its natural service capabilities offer the ideal way to support the largest user communities. When VSATs are combined with new fiber backbone networks and advanced national networks, the user capability features will be enhanced, offering greater demand for advanced information movement management.

REFERENCES:

1. A. Mahmoodshahi, "Spread Spectrum System", AT&T Bell Lab. Internal Memo, File Case 40370-006, January 28, 1986.
2. M.B. Pursley, "Performance Evaluation for Phase-Coded Spread Spectrum Multiple Access Communication Part I", IEEE Transaction on communication Vol. 25,1977.
3. M.B. Pursley, "Performance Evaluation for Phase-Coded Spread Spectrum Multiple Access Communication Part II", IEEE Transaction on communication Vol. 25,1977.
4. D.V. Sarwate and M.B. Pursley, "Crosscorrelation properties of Sequences Generated from Cyclic Error-Correcting Codes", Technical Report TR-146 Jan, 1981.
5. R. Currier "Engineering Note", AT&T Bell Lab. Internal Memo, File Case 40370-006, Oct 1985. pseudorandom and related sequences", Proceeding of IEEE, Vol. 68, May 1980.

BIOGRAPHY

Dr. Alireza Mahmoodshahi was born on March 8, 1954. He received his B.S.E.E from Gondishapoor University in IRAN, and his M.S.E.E, and Ph.D from George Washington University in 1977, 1979 and 1988, respectively. During his undergraduate studies, he received national scholarship from the Iranian Ministry of Higher Education. He also received scholarships from G.W.U during his graduate work. Dr. Mahmoodshahi was with COMSAT from 1982-1985. From 1985 he has been with AT&T Bell Laboratories in Holmdel NJ. He is presently responsible for research and development in VSAT and other international services. Dr. Mahmoodshahi is a member of IEEE and officer of Microwave Transaction Technique (MTT).

PORTABLE SATELLITE TERMINAL FOR VOICE COMMUNICATIONS NETWORK

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1. ABSTRACT

This paper describes the development of the most advanced and completly portable small earth station using VSAT (Very Small Aperture Terminal) technology providing one duplex SCPC (Single Channel Per Carrier) channel.
The newly designed VSAT, named NEXTAR-LITE™, not only provides reliable and clear two-way voice or data communication but also can be used to receive television at remote areas. It has been specifically designed to answer requirements such as portability, easy transportation, simple operation, fast satellite acquisition, environmental resistance, low cost and low power consumption.
It will bring great benefits to rural and remote areas such as Pacific Islands countries. This paper outlines the design objectives, the system design, applications, operation image and the technical characteristics of the NEXTAR-LITE™ system.

2. INTRODUCTION

The present satellite communication system which is already in operation in almost all countries in the world provides an efficient and versatile solution to the modernized urban or rural areas.

Recently very small aperture terminals (VSAT) systems for data only applications have become popular among private network developers who choose to bypass the carrier supplied terrestrial networks. Two-way data service using VSAT system is expensive because of the need for massive hub station. In addition to this cost, it also cannot be economically equipped for telephone service.

In another aspect, mobile satellite systems are being planned to provide coverage in many areas where terrestrial coverage is not economically feasible. Though it will bring vital communications capabilities to the rural areas and provide excellent mobile communications to the public at large, it is necessary to provide new infrastructure and long term planning for realization.

Rural and remote areas around the globe are experiencing a growing demand for reliable and inexpensive telecommunication service in the near future. This presentation will focus on the development of a portable satellite terminal (NEXTAR-LITE™) providing the most attractive and economical way of communication for both voice and data services utilizing the existing networks.

3. PORTABLE SATELLITE TERMINAL

3.1 DEVELOPMENT BACKGROUND

In Japan it is only one year since the first three commercial domestic satellites at Ku-band (14/12 GHz) were being launched. They have already provided great benefits in various areas such as SNG (Satellite News Gathering) systems for broadcasting companies, CATV program distribution systems, data network systems using VSATs, educational broadcast systems, emergency communication and so on. In these areas there is a strong demand for a small portable earth station providing voice or low speed data communication for SNG order-wire, natural disasters, special events or emergency medical communications.

On the other hand there is an another demand for a relatively small and low cost earth stations serving the vast majority of the world's population who live in rural or remote areas and who are hampered in their economic and social development by inadequate long distance communications facilities.

In order to cope with these demands, the portable satellite terminal called NEXTAR-LITE™ was developed in 1990.

3.2 DESIGN OBJECTIVES

Specifically our main objectives in carrying out the development of the NEXTAR-LITE™ are:
(1) Direct voice communication using normal two-wire telephone and interconnection to the global telephone network;
(2) Low speed data communication up to 9600 bps for facsimile, personal computer and still video camera/monitor equipment using an external data modem;
(3) Full mesh or star Demand Assigned Multiple Access (DAMA) operation;
(4) Low power consumption for battery operation such as rechargeable battery pack, car battery or solar battery;
(5) Light weight design to ease transportation and installation;
(6) System compatibility with existing network (DOMSAT & VISTA);
(7) Low cost satellite terminals;
(8) Ku and C-band operation;
(9) Either portable or fixed installation;
(10) Multi-carrier operation;
(11) Economical PAMA operation

In order to realize above requirements, we conclude that the most effective solution is Companded Frequency Modulation Single Channel Per Carrier (CFM-SCPC) technique. In addition to the

modulation technique it also can be effectively incorporated with the existing NEC Digital VSAT system, using 0.75m, 1.2m, 1.8m, 2.4m or large antenna and outdoor RF equipment.
Since NEC is one of the pioneers in digital VSAT suppliers, various antennas and outdoor units are readily available in both Ku-band (14/12 GHz) and C-band (6/4 GHz). The NEXTAR-LITE™ may be called as the analog version to the existing digital VSAT system.

3.3 SYSTEM OUTLINE

The NEXTAR-LITE™ system is designed to provide CFM-SCPC voice channels, facsimile, low speed data and still color video communications between a small center hub earth station and widely scattered NEXTAR-LITE™ terminals in a star network configuration. In the case of star configuration the hub station consists of a relatively large antenna and existing CFM-SCPC TERMINAL providing many channels. Figure 1 shows the star configuration of the NEXTAR-LITE™ system.

The star network does not suit all applications because some networks carrying significantly large amount of traffic may require direct links between local stations. Thus the system becomes a partly or totally meshed network. Point to point or mesh configuration are also available according to the link budgets. Figure 2 shows the mesh (point to point) configuration of the NEXTAR-LITE™. Table 1 shows the link budgets of C & Ku-band of the NEXTAR-LITE™ system.

Demand Assignment Multiple Access (DAMA) system is used to ensure maximum utilization of the available satellite channels.

The CFM-SCPC full mesh DAMA network was developed by NEC for SNG order-wire providing voice or data communication to the broadcasting companies or SNG cars and was in operation since 1989 using the Ku-band of the JC-SAT (one of the Japan domestic satellite).
This system was also used in Solomon Islands Public Switched Telephone Network (PSTN) providing communication to some remote islands via INTELSAT C-band transponder. In 1989 INTELSAT approved this system as the first SUPER-VISTA system in the world.

The above two systems are equipped with 19-inch Channel Units in a standard rack. Each channel unit can accommodate up to five (5) channels including both DAMA controller (SDC) and subscriber interface circuit. These equipment can also be used in the hub station of the NEXTAR-LITE™ system. Figure 3 shows the configuration of the CH UNIT.

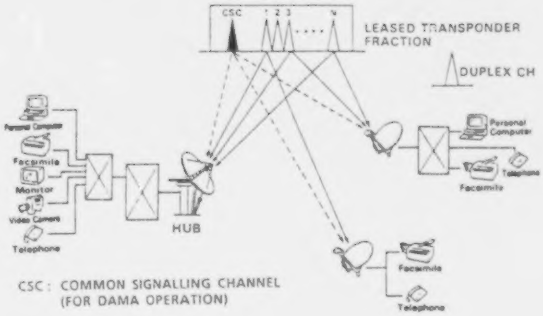
CSC
1 2 3
N
LEASED TRANSPONDER FRACTION
DUPLEX CH
Personal Computer
Facsimile
Monitor
Video Camera
Telephone
HUB
Personal Computer
Telephone
Facsimile
Facsimile
Telephone
CSC: COMMON SIGNALLING CHANNEL (FOR DAMA OPERATION)

Fig 1. STAR CONFIGURATION

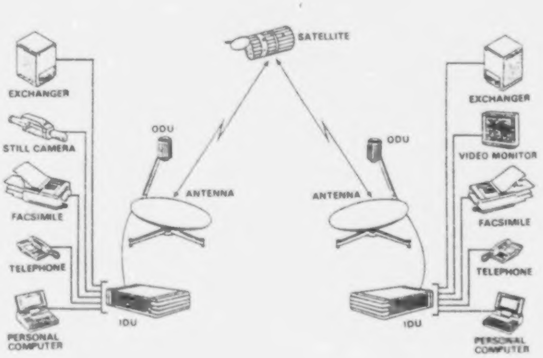
SATELLITE
EXCHANGER
STILL CAMERA
FACSIMILE
TELEPHONE
PERSONAL COMPUTER
ODU
ANTENNA
IDU
ODU
ANTENNA
IDU
EXCHANGER
VIDEO MONITOR
FACSIMILE
TELEPHONE
PERSONAL COMPUTER

Fig 2. MESH CONDIGURATION

Table 1. LINK BUDGET (TYPICAL)

SATELLITE / PARAMETER	C-BAND (PRIVATE)	C-BAND (INTELSAT)	Ku-BAND (PRIVATE I)	Ku-BAND (PRIVATE II)
SAT EIRP (SATU.)	34 dBW	23.5 (G/G)	50.8	43
SAT G/T	−5 dB/K	−16	11.3	−2
SAT SFD	−86 dBW/m²	−85.1 (EX-HIGH)	−91	−80
SAT IBO/OBO	8.5/4.5 dB	9/4	5.2/3.4	5.8/3.0
C/T UP LINK	−167.0 dBW/K	−172.4	−156.6	−162.6
C/T DOWN LINK	−170.7 dBW/K	−169.5	−171.0	−164.4
C/T SATELLITE	−168.4 dBW/K	−164.2	−167.3	−171.3
YEARY AVAILABILITY	99.9% MIN.	99.5 MIN	99.5 MIN	99.5 MIN
OPERATION C/T (C/No)	−174.6 dBW/K (54 dBHz)	−174.6 (54)	−174.6 (54)	−174.6 (54)
VSAT EIRP/CH	38.6 dBW	44.2	39.9	47.3
HUB	6 M	11 M	0.75 M	6.4 M
VSAT	1.8 M	1.8 M	0.75 M	1.2 M
MIN CH/VSAT*	2 CH	1 CH	1 CH	1 CH
	(5W)	(5W)	(1.5W)	(3W)

* More Channels depends on an actual operating conditions

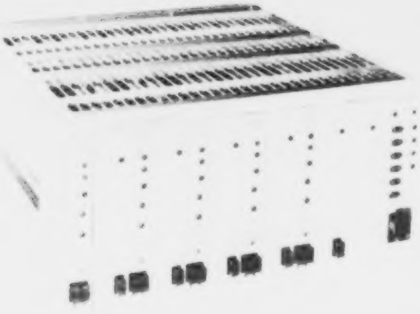

Fig 3. CONFIGURATION OF CH UNIT

3.4 EQUIPMENT OUTLINE

3.4.1 TERMINAL CONFIGURATION

In case of the portable terminal for Japan domestic satellite system a typical configuration of the NEXTAR-LITE^{TM} consists of a portable parabolic antenna, an Outdoor Unit (ODU) with feed horn, an interfacility Link (IFL), and Indoor Unit (IDU). Power for the terminal comes from an external battery, solar battery, commercial mains or AC/DC generators. The block diagram of the NEXTAR-LITE^{TM} is illustrated in Figure 4. The mechanical overall configuration of the NEXTAR-LITE^{TM} is illustrated in Figure 5.

According to the above figure, only one pair of channels provides a full-duplex link or a trunk between any of the stations in a network. This is accomplished through the Indoor Unit. The IDU is equipped with a Modulator/Demodulator (MODEM) capable of transmitting or receiving any SCPC channels at the 1GHz band and is equipped with compandor.A Channel Trunk Unit (CTU) is used to command the MODEM to tune to the apporopriate frequency according to the Secondary DAMA Controller (SDC) and to interface with terrestrial telphone.A LOGIC is used to control and supervise the overall function of IDU and ODU. The mechanical configuration of IDU is very compact and easy to carry at outdoors. Figure 6. shows the configuration of IDU.

The IDU is connected to the ODU by using one single IFL cable. The ODU consists of 1.5W HPC (High Power Converter) and 225K LNC (low Noise Converter) at Ku-band. The antenna is a portable parabolic dish type and its aperture is 0.75m which is the smallest type for 2-way VSAT. Another antenna diameters are available in order to optimize the system configuration.

3.4.2 PORTABILITY

The NEXTAR-LITE^{TM} has a principal role in serving remote locations, temporary locations, or places difficult to access. In order to meet this requirement adequately, the portability specification placed on the equipment is that it can be entirely carried, by one person, in a light traffic method such as a car, small plane or helicopter.

A typical NEXTAR-LITE^{TM} is transported in one(1) rugged, splash-proof portable IDU and four(4) carring cases for the antenna and ODU. The most important item with respect to the portability is the antenna. For communications in the Ku-band using the Japan domestic satellite, the antenna size is available as small as 0.75m in diameter and meets the required electrical performance according to the link budget calculation.

The 0.75m antenna can be divided into three small sections such as a reflector, ODU support and tripod. The total weight of the antenna including three soft cases is 58 pounds (26.5kg). The ODU unit weights 28 pounds (13kg) including one rugged carring case. The IDU unit weights only 22 pounds (10kg). Each NEXTAR-LITE^{TM} unit weights less than 32 pounds (14.5kg) and the total weight is only 109 pounds (49.5kg). Only one person can easily sling it into a small plane, helicopter, or car to cover news and sports. It is the best assistant tool in disaster recovery, goverment service, mineral exploration and many other similar applications.

3.4.3 SATELLITE ACQUISITION

Rapid deployment in remote areas is an important requirment for the portable terminal. The three antenna units are so simple and light that no tools are required for set-up. An inclinometer built in the antenna and signal-strength-meter contained in the IDU MONITOR of the IDU accessory kit simplify the required azimuth and elevation adjustment. Precise setting can be achieved by moving the antenna slightly to "peak" the S-meter using actual satellite signals.

The specified time for set-up of the terminal, from arrival on site to establishment of communications, is only 10 minutes with one non-skilled person.

3.4.4 POWER REQUIREMENTS

In the places where electricity is not easy to find, the best solution is a re-chargeable Ni-Cd battery pack for portable operation. To realize battery operation, the NEXTAR-LITE^{TM} adopts the following low power consumption techniques.

(1) Low power device and circuit
(2) Voice activated power control of the ODU
(3) High efficiency DC/DC CONVERTER

The power consumption of the NEXTAR-LITE^{TM} is as follows:

-90W (approximate) at TX carrier on
-50W (approximate) at stand-by

For example in the case of DAMA operation a small battery pack (capacity 8.8 AH) can be used approximately for about 2 hours due to the low power consumption of the terminal.

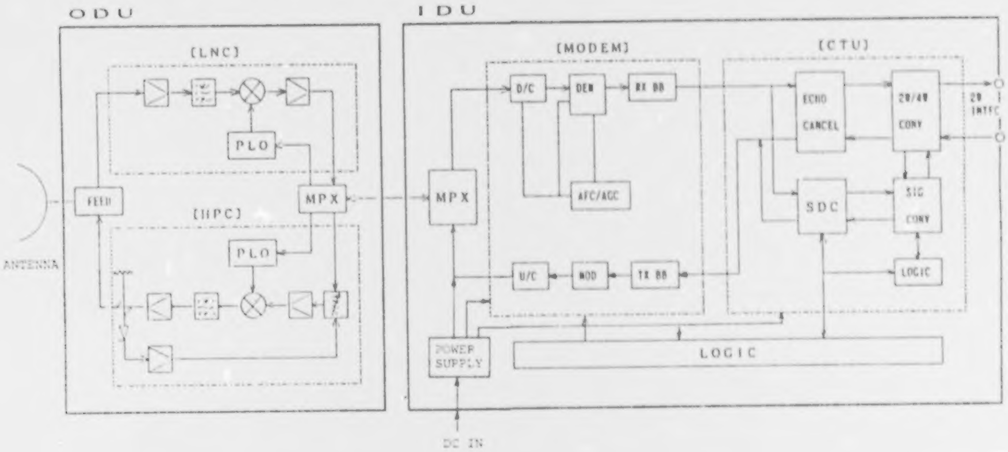
ODU
IDU
[LNC]
PLO
FEED
MPX
[HPC]
PLO
ANTENNA
[MODEM]
D/C
DEM
RX BB
AFC/AGC
U/C
MOD
TX BB
MPX
[CTU]
ECHO CANCEL
2W/4W CONV
2W INTFC
SDC
SIG CONV
LOGIC
POWER SUPPLY
LOGIC
DC IN

Fig 4. BLOCK DIAGRAM OF NEXTAR-LITE^{TM}

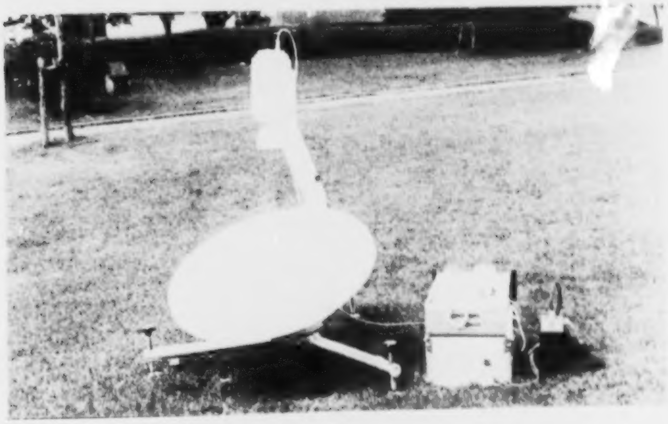

Fig 5. CONFIGURATION OF NEXTAR-LITE^{TM}

Fig 6. Indoor Unit

3.5 PERFORMANCE (Ku-band)

3.5.1 ELECTRICAL PERFORMANCE

(1) RF FREQUENCY : TRANSMIT 14.0-14.5 GHz
RECEIVE 12.25-12.75 GHz or 11.70-12.20 GHz
(2) ANTENNA DIAMETER: 0.75m portable or 0.75m/1.2m/1.8m/2.4m fixed type
(3) RECEIVE NOISE TEMPERATURE : 250K or 225K
(4) RF SATURATED POWER : 1.5W or 3.0W
(5) IFL CABLE : up to 100m (single coaxial cable)
(6) RF FREQUENCY AGILITY : 25/30/45/50 kHz spacings over 500 MHz
(7) MODULATION : CFM-SCPC with voice activation
(8) COMPANDOR : CCITT Rec. G.162
(9) ECHO CANCELER : CCITT Rec. G.165
(10) S/N RATIO : more than 50 dBp at C/N= 10dB with compandor
(11) DATA TRANSMISSION : up to 9600 bps
(12) CUSTOMER INTERFACE : 2-wire FXS/FXO or 4-wire E&M
signaling :
-decimal
-R2 CCITT pulse code
-MF signal
(13) DAMA : full mesh or star configuration up to 256 duplex channels capacity with network manegement
(14) TV RECEIVER : 950-1450 MHz

3.5.2 ENVIRONMENTS

(1) Operation Wind Velocity : 20 m/s
(2) Operating Temperature
Outdoor Unit : -30 to +55 deg
Indoor Unit : -10 to +45 deg

3.5.3 POWER REQUIREMENTS

(1) DC operation : 10 to 32 V
(2) AC operation : 100/115V±10% or 220/240V±10%

4. APPLICATIONS

4.1 RURAL TELECOMMUNICATIONS

In spite of the fact that satellite technology has been effectively used for over 20 years, still there are many remote and rural areas in the devloping countries which have little or no means of basic telecommunications. So it is our responsibility to develop a reliable and economical satellite communication system to assist the modernization process for rural and remote areas of the developing countries.

VISTA is designed to provide the basic satellite communications facilities of voice, telex, teletype, and low-speed data for rural and remote areas presently having inadequate or no telecommunication. One of the NEXTAR-LITE^{TM}'s applications is the VISTA or Super VISTA. The VISTA or Super VISTA system are operated at C-band of the INTELSAT satellite. The INTELSAT is one of accessible satellite for the NEXTAR-LITE^{TM} system, subject to link budgets and an advance consultation to the INTELSAT, for non-standard operation.

Table.2 shows the allowable channel number of the C-band operation. It shows that reliable communications from anywhere in the world can be available because the NEXTAR-LITE^{TM} can operate with an INTELSAT global coverage C-Band beam.

The NEXTAR-LITE^{TM} has other benefits for rural communications:
(1) Solar Operation:
For locations where no commercial power is available and gasoline or other fueled generators would not be pratical, solar power can provide the solution. The NEXTAR-LITE^{TM} is the most suitable system for solar operation, because of low power consumption.
(2) Economy:
The NEXTAR-LITE^{TM} realized the most economical service by applying a combination of VSAT technology and SCPC-CFM technology.

4.2 LIVE COMMUNICATIONS

For journalism it is necessary to have radio broadcast or TV broadcast to communicate the latest news to their head office immediately from the place of event. Usually they use various information tools such as a telephone, facsimile TV camera and personal computer. The NEXTAR-LITE^{TM} is the most suitable to these applications which can act as the interface between the place of event and the broadcasting company.
Figure 7 shows the operation image of this application.

4.3 EMERGENCY COMMUNICATIONS

When natural disasters such as earthquakes, tornadoes, floods and so on are occurred, satellite communication has significant advantages over alternative systems. In particular, a portable terminal is very useful due to immediate channel establishment. The NEXTAR-LITE^{TM} provides the most suitable back-up communications system.

4.4 REMOTE MONITORING, OBSERVATION AND SURVEILLANCE

The NEXTAR-LITE^{TM} is very useful in gathering information such as meteorological observation data, vibroscope data, water level data, ect, from various remote areas. It can be powered using a solar battery due to its low power comsumption and also it can provide unmanned operation which makes it the ideal system for the above applications.

4.5 MULTI-CARRIER OPERATION

The typical NEXTAR-LITE^{TM} is only one(1) channel earth station in order to simlify and miniaturize the equipment. However, there is an optional method to transmit up to four(4) channels by one(1) VSAT antenna. In this case, the Multi carrier Controller (MCC) is installed between the ODU and IDU. Though channel capacity dependes on a link budget, the MCC can support up to four(4) IDUs.

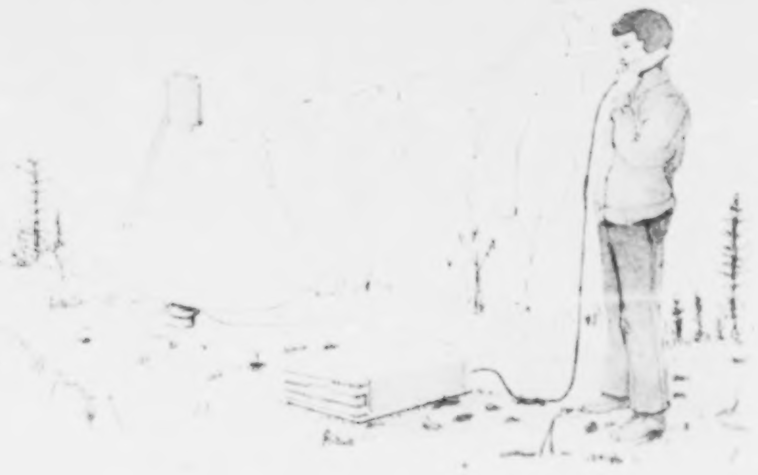

Fig 7. OPERATION IMAGE

4.6 OTHER APPLICATIONS

(1) OIL EXPLORATION AND PRODUCTION
Voice and data communications to oil field drilling rigs require reliable, enviromentally-protected equipment. The NEXTAR-LITE^{TM} meets these low-volume traffic requirements reliable and econiomically.

(2) CONSTRUCTION
Large remote construction projects often require reliable temporary communications while permanent facilities are being planned and installed.

(3) NATIONWIDE PAGING
A network of NEXTAR-LITE^{TM} would enable economical, nationwide paging. Use of DAMA transmission techniques makes this concept even more attractive.

(4) EMERGENCY MEDICAL COMMUNICATION
In remote areas the NEXTAR-LITE^{TM} can play important role by providing medical facilities or doctor for emergency.

Table 2. NETWORK APPLICATION EXAMPLE (C-BAND)

Hub Ant. Dia.	Typical DOMSAT			INTELSAT Global Beam		
	VSAT with 5 W / 80 K ODU + The Following Ant Dia.					
	1.8 m	3.6 m	4.5 m	1.8 m	3.6 m	4.5 m
1.8 m	–	1 CH	1 CH	–	–	–
2.4 m	–	1 CH	2 CH	–	–	–
3.6 m	1 CH	2 CH	4 CH	–	–	1 CH
4.5 m	1 CH	4 CH		–	1 CH	1 CH
6 m	2 CH			–	1 CH	1 CH
7.6 m	2 CH			–	1 CH	2 CH
9.2 m	3 CH			–	1 CH	2 CH
11 m	3 CH			1 CH	1 CH	3 CH
13 m	4 CH			1 CH	2 CH	3 CH
16 m	4 CH			1 CH	2 CH	4 CH
Remarks						Super VISTA

5. CONCLUSION

It has been over five years since NEC Corporation first designed its VSAT, named NEXTAR^{TM} for interactive data transmission using an original AA-TDMA technique. In another aspect, NEC Corporation is one of the primary CFM-SCPC equipment suppliers and has made a great contribution to DOMSAT or VISTA service all over the world. Such a long experience in satellite communication played an important role in developing the NEXTAR-LITE^{TM} system.

This paper showed that the NEXTAR-LITE^{TM} provided voice and data communications using a compact, portable antenna or fixed antenna. Although the NEXTER-LITE^{TM} has a lot of applications, the primary application is to provide the most economical telecommunications service to remote and rural areas such as Pacific Islands countries where there are poor or non-existent telecommunication service due to economical problems.

We belive that the NEXTAR-LITE^{TM} is an ideal solution to above problems by being compatible with existing public network and utilizing a low cost RF equipment of VSAT.

The authors hope that the information given in this paper will be helpful for planning engineer of public or private communication systems.

ACKNOWLEDGMENT

The authors are grateful to the NEC Corporation for permission to publish this paper. The work was advised by the JCSAT and was performed in the NEC's Microwave & Satellite Communication Division. Thanks are due to Dr.J.G.Beitchman, Mr.K.Ando of JCSAT and Mr.H.Shimayama, Mr.H.Hayashi, Mr.A.Shimizu, Mr.G.Ohshima, Mr.Y.Fukuda, Mr.Y.Hoshino, Mr.A.Takahara, Mr.K.Kosukegawa, Mr.K.Ikeda of NEC for their helpful encouragement and guidance during the course of the work.

REFERENCES

1. T.Tokunaga and H.Adachi, "SOLSTAR (NEC's Solar Powered Small Earth Station)" PTC'88, Hawaii, January 1988.

2. R.H.Lekowski et al. "SNG Order Wire DAMA System" NEC TECHNICAL JOURNAL, Vol.43 No.4, May 1990.

CHILE'S DIGITAL NETWORK:
MARRIAGE OF IDR, VSAT, AND FIBER OPTIC TECHNOLOGIES

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Norcross, Georgia

1.0 ABSTRACT

This paper will discuss various techniques to maximize traffic capacity of a fixed satellite bandwidth used in the design of the CTC DOMSAT Network.

2.0 INTRODUCTION

Compañía de Teléfonos de Chile (CTC) has contracted with Scientific-Atlanta for the largest digital domestic satellite communications network in the world. This completely digital network combines Intermediate Data Rate (IDR), VSAT, and Fiber Optic technologies into a major network with end to end digital connectivity for both heavy route and thin-route data and voice traffic.

Chile has long recognized the benefits of telecom deregulation and took the first steps toward privatization about the same time as was occurring in the United States. There are five public service telephone companies in Chile, including CTC. While ENTEL has been the traditional supplier of long-distance and international communications, CTC has been in the telecommunications business since shortly after the invention of the telephone and currently provide local telephone service throughout most of Chile.

As in many industrial countries, Chile has experienced a tremendous growth in demand for data and telephone communications, which CTC's new network seeks to address. Chile's strong, stable economy, natural resources, and booming industrial economy have fueled telecommunications demand. Industries across the board are growing and require reliable digital communications to remain competitive at home and abroad. The IDR system will be especially valuable for the mining, manufacturing, and financial industries while the VSAT system can provide interactive data for the financial, retail, hotel, and airline industries. The fiber optic technology will be used to provide a connection between the major earth station locations and the local digital switching centers for the heavy route digital traffic.

This network for CTC was an engineering challenge to design, as the CTC network required planning for unprecedented traffic in a fixed amount of bandwidth. As the IDR traffic alone represented 95% of the bandwidth consumed, this paper will focus on the design techniques utilized to contain this IDR traffic within the allocated bandwidth.

3.0 TRAFFIC OVERVIEW

The intent of the CTC Domestic Satellite (DOMSAT) Network is to provide for the distribution of over 2,000 duplex telephony voice and data circuits in Chile. This traffic will be a mixture of heavy route traffic to a few major urban areas and thin route traffic to many remote locations. Additionally, dozens of small aperture (VSAT) earth stations will provide low speed data service. All of the traffic in the CTC Network is routed to a hub station in Santiago to form a star network.

To effect this traffic growth, CTC purchased a 72 MHz transponder of the Pan American Satellite (PANAMSAT) to carry all of the channels of the CTC DOMSAT Network. As the cost of additional satellite transponder space is extremely expensive, the most important objective in the design of the CTC Network was to contain all of CTC's traffic within this single 72 MHz transponder. CTC and Scientific-Atlanta considered various design methods before arriving at the final solution. First the traffic was categorized into three types: the heavy route traffic having over 100 channels, the thin route traffic having less than 60 channels, and the low speed data. Then various modulation schemes were considered as are summarized in the following discussion.

4.0 ANALOG POSSIBILITIES

Historically, the most popular satellite communications modulation scheme has been analog FM. For the CTC traffic plan, one design approach could have been to use companded frequency division multiplex (CFDM) links for the traffic of the major areas, single channel per carrier (SCPC/CFM) links for the thin route stations and for the low speed data, and digital carriers for the 64 kb/s traffic. Unfortunately, this method would require over 145 MHz of transponder bandwidth which is more bandwidth than contained in two 72 MHz transponders.

5.0 IDR SERVICE

As the CTC Domestic Satellite Network represented a large monetary investment on the part of CTC, one of CTC's primary objectives was to have the most modern equipment available which would remain up to date for many years and which would utilize the latest technology to deliver the best possible quality of service. This meant one word, digital. Consequently, an analysis was made using various digital transmission schemes. A logical first step was to consider a design based upon the traditional CCITT 64 kb/s PCM encoding method of the voice traffic and the IDR/IBS type of satellite service defined in INTELSAT documents IESS-308 and IESS-309. The CCITT and INTELSAT have defined a group of standard data rates, standard data framing, and standard modem overhead requirements making possible open network operation between equipments from different manufacturers. While this standardization can be good for open network operation, it can often be very inefficient for the closed network operation of a DOMSAT network when trying to maximize traffic capacity for a given space segment lease. Some of the sources of this inefficiency are listed as follows:

- Excessive bandwidth for 64 kb/s PCM Voice Coding
- Excessive bandwidth for ESC overhead
- Limited selection of FEC rates

- Single choice of decoding algorithms
- Limited selection of multiplexer aggregate rates.

The following discussion presents how a tailored engineering approach differing from certain IESS and CCITT open network standards was the key factor in the successful design of the closed CTC DOMSAT Network.

5.1 64 KB/S PCM VOICE CODING

A single 64 kb/s PCM voice channel on a rate 3/4 FEC QPSK carrier requires a satellite bandwidth allocation of approximately 60 kHz. This means that approximately 240 MHz of satellite bandwidth would be required to accommodate the over 4,000 satellite channels of the CTC DOMSAT Network. This equates to three 72 MHz satellite transponders plus one 36 MHz satellite transponder.

One of the most effective means to maximize space segment efficiency is by digital circuit multiplication system technology known as DCMS. DCMS systems utilize a varying 24 or 32 kb/s ADPCM algorithm plus digital speech interpolation techniques to provide substantial reductions in data rate requirements. Depending on the quantity of data traffic and the equipment manufacturer, a DCMS system can result in bandwidth reductions of approximately 80%. A single 2048 kb/s CEPT trunk which normally supports 30 PCM channels can support up to 200 voice channels using DCMS technology. This results in a 6:1 multiplication ratio which will vary with percentage of clear channel data and voice band data traffic.

DCMS technology is best suited for stations having a very high traffic requirement for two reasons. First, the best multiplication ratio is obtained in the presence of higher volumes of traffic. Second, DCMS terminals can be one of the most expensive items in an earth station and are cost effective only where a high volume of traffic can generate enough revenue to justify the expense. In the CTC DOMSAT Network, the stations located in the major urban areas were identified as being ideal for this tech-nology as each station has voice traffic demands ranging in excess of 100 circuits. Using the DCMS technology an overall reduction in the transponder bandwidth require-ments for this type of traffic of nearly 81% was achieved.

The majority of the thin route earth stations of the CTC DOMSAT Network have traffic requirements of less than 20 channels. Accordingly, DCMS technology would not have been a beneficial expenditure in these stations. Rather, each voice channel was encoded using 32 kb/s ADPCM to result in a bandwidth savings of 50% over the 64 kb/s PCM voice encoding scheme.

5.2 ESC OVERHEAD

A fundamental requirement of satellite earth stations is to provide an Engineering Service Circuit (ESC) for communication between earth station locations. The type and capabilities of the ESC varies with the type of ESC traffic at each earth station. For example, an unattended remote earth station would not benefit from having the sophisticated voice and telex orderwire subsystems required by INTELSAT Standard A Gateway Earth Stations.

IESS-308 provides for ESC service by requiring that 96 kb/s of overhead on a 2048 kb/s carrier be allocated for ESC service to include a low speed data channel and two voice channels. This additional overhead increases the bandwidth of each carrier by 5%. In most DOMSAT applications such as CTC's, this level of sophistication of ESC service is not required and only results in wasted bandwidth.

In the CTC network, two bandwidth efficient methods of ESC service will be used. The major urban stations are to be fully manned earth stations and would benefit by a voice orderwire service. Each urban station is equipped with digital circuit multiplication system (DCMS) equipment in which each DCMS terminal already contains its own voice orderwire. This orderwire channel is treated as a normal telephone channel in the circuit multiplication process to provide earth station to earth station communications without any additional equipment or satellite bandwidth.

Most of the CTC remote stations are to be unmanned earth stations which would benefit more from a telex type of ESC service. Being unattended stations, they are provided with a sophisticated monitor and control (M&C) system permitting full status and control from the hub station. This M&C system features a computer with keyboard and display at each station, which communicates with the hub station via a low speed data channel operating at 1.2 kb/s. Rather than dedicate additional capacity for ESC service, the ESC service will be via electronic mail between the computers using the same M&C carriers. The messages are stored in the computer memory until required for viewing by maintenance personnel. Because the M&C traffic operates at such a low data rate, very little bandwidth is required to provide this type of ESC service.

Using these two methods of implementation for the ESC service versus the IESS-308 method, a very considerable savings of nearly 5% of the transponder's 36 MHz bandwidth (approximately 1.7 MHz) was realized.

5.3 FEC RATES

The INTELSAT IESS-308/309 documents only include forward error correction (FEC) rates of 1/2 or 3/4. This means that the required bandwidth is increased by 33% to 50% of the information rate due to forward error correction. When transponder bandwidth is an important concern as in the CTC DOMSAT Network, use of alternative FEC rates may be more desirable. Rate 7/8 FEC is used in the CTC DOMSAT Network resulting in a bandwidth increase of only 14% of the information rate due to forward error correction. While it is true that the rate 7/8 carriers require more satellite power than rate 1/2 or 3/4 carriers, the traffic capacity of satellite networks accessing the high power spot beams available on PANAMSAT, PALAPA, ASIASAT, and others is often limited by transponder bandwidth rather than transponder power.

5.4 DECODING

The INTELSAT IESS-308/309 documents specify a Viterbi decoder. Table 1 presents the BER vs. E_b/N_o performance of the Scientific-Atlanta Model 8880 QPSK Modem which is available in both Viterbi and Sequential decoding versions. As seen in Table 1, there are cases in which the Viterbi decoder requires a higher E_b/N_o and consequently more satellite power than the Sequential decoder. For example the Viterbi decoder requires 0.7 dB higher E_b/N_o than the Sequential decoder to achieve a BER of 10^{-7} for a 2048 kb/s carrier using rate 3/4 FEC. Prior to the selection of the FEC rate for the CTC DOMSAT Network, it was decided that the Sequential decoding process would be used as a power preservation measure.

Table 1
IF Looped BER Performance
Scientific-Atlanta Model 8880 QPSK Modem

SEQUENTIAL DECODER

	BER	R=7/8	R=3/4	R=1/2
56 kb/s	10^{-5}	6.9	6.8	4.9
	10^{-6}	7.5	6.3	5.4
	10^{-7}	8.1	6.7	5.8
1544 kb/s	10^{-5}	7.2	6.4	5.9
	10^{-6}	7.7	6.9	6.3
	10^{-7}	8.1	7.3	6.8
2048 kb/s	10^{-5}	7.3	6.6	6.2
	10^{-6}	7.7	7.1	6.6
	10^{-7}	8.1	7.6	7.0

VITERBI DECODER

	BER	R=7/8	R=3/4	R=1/2
All rates	10^{-5}	n/a	6.9	5.4
	10^{-6}	n/a	7.6	6.1
	10^{-7}	n/a	8.3	6.7

5.5 MULTIPLEXER AGGREGATE

The aggregate rate of a multiplexer is defined to be the multiplexer's output data stream which is composed of the voice and data channels multiplexed in time. This aggregate in turn becomes the information rate of the satellite modem so that the required satellite bandwidth is directly related to the aggregate rate.

The traditional method of multiplexing many digitized voice or data channels onto a single aggregate data stream is to use CEPT or T-1 channel bank type multiplexers. These multiplexers have an aggregate rate of 2048 or 1544 kb/s regardless of traffic requirements. This limited range of possibilities can be a major obstacle to optimizing traffic capacity versus available bandwidth.

In most DOMSATs including CTC's, the variation of traffic capacity with each station requires that a more flexible method of multiplexer be used. There are several such multiplexers available on the market today which have the capability of customizing an aggregate rate very near to the exact traffic requirements of a station by creating an aggregate from only the voice, data, and signaling information bits plus some minimal multiplexer overhead. Using these multiplexers for the CTC DOMSAT Network, it was possible to match each of the six different remote station traffic capacities to a specific aggregate data rate resulting in minimal wasted satellite bandwidth. This multiplexer flexibility was second only to the DCMS in importance with respect to containing the CTC traffic within the allocated transponder bandwidth.

6.0 VSAT SERVICE

The Scientific-Atlanta SkylinX.25 VSAT design features the capability to transmit packetized low speed data via a 64 kb/s BPSK carrier. Depending on the type of service to be provided, each VSAT carrier can support up to 100 VSAT stations. With a FEC rate of 1/2, each VSAT carrier occupies 128 kHz of satellite bandwidth. In order to provide for adequate spacing against adjacent carrier interference, a 200 kHz is allocated for each VSAT carrier.

Using the design techniques previously discussed for the IDR traffic, sufficient bandwidth remained in the CTC transponder to assign 2 MHz for VSAT service. This 2 MHz bandwidth will accommodate 5 inbound and 5 outbound VSAT carriers which can provide service for hundreds of VSAT earth stations.

7.0 CONCLUSION

While traditional CCITT and INTELSAT standards are well conceived and essential for successful coordination of international traffic, a domestic satellite network often can benefit greatly from a system design engineered to the specific technical and traffic requirements of that network. As demonstrated by the previous discussion of the design of the CTC Domestic Satellite Network, deviation from the standardization established by the CCITT and INTELSAT can result in substantial increases in traffic capacity for a fixed satellite bandwidth while maintaining the high degree of service quality required in modern telephony. Organizations planning a domestic satellite network are well advised to consider these alternatives during the design of their networks so as to maximize their revenue producing traffic capacity for a fixed satellite transponder cost.

The Mobile Communications Revolution – An Update

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Abstract

In 1991 significant progress will be made in the global "personalization" of telecommunications. Low-cost, compact, mobile satellite terminals and services will appear; initial installations of digital cellular telephones and personal communications networks will occur; and a global mobile data network will expand. This presentation will survey the status of these developments with respect to service offerings, technology, and impact on the global and Pacific Rim communities.

Introduction

In 1991, the globalization of personal communications will take a major stride forward. In the coming year, we can expect to see: expanded service offerings to aircraft, ships and vehicles through satellites designed for both mobile applications as well as traditional fixed satellite services; pre-operational services of new, compact, earth stations (mobile and portable) supporting facsimile, data, and compressed digital voice on land and at sea; introduction of new digital cellular telephone offerings in Europe and North America which will capitalize on service economies to radically expand the installed customer base for those services; experiments in new-generation digital cordless telephones and personal communication networks in Japan, North America and Europe which should lead to standards and/or technologies that will foreshadow the coming of a wireless global community; and, finally, implementation of sophisticated national and international mobile data networks capable in the near future of supporting acknowledgement pagers and personal electronic messaging services.

Also during 1991, many governmental agencies worldwide will be preparing their nations' positions with respect to frequency allocations for personal communications networks (PCN) in anticipation of the 1992 WARC.

The year just past also held a few surprises for those of us in the industry. In the US, well over 30 applications were received by the Federal Communications Commission for experiments in personal communication networking in anticipation of a ruling by the FCC with respect to that activity over the next 18 months to two years; a number of applications were received from companies wishing to transmit high quality radio (and even compact-disc quality audio) to vehicles and residences via satellite; and the FCC opened the competitive arena to multiple service providers of air-to-ground services for commercial aviation. In Japan, the MOPT drafted proposed standards for digital cellular telephony and a second generation digital cordless telephone; initial experiments on the latter are planned for the fourth quarter of 1991. In Europe, the GSM European digital cellular standard was endorsed for adaptation to PCN throughout Europe, albeit in a different frequency band.

The trend is unmistakable: a perception is growing throughout the global community of a need for advanced data, image, voice, and audio offerings on an international scale. Implementation of these offerings will require, among other elements, subscriber units that are compact and low cost, networks that are ubiquitous, and a level of service charges that can make these capabilities available to the masses as opposed to commercial enterprises. It is also clear that world regulatory bodies and governments, and high technology industries and entrepreneurs are responding to these perceived needs. Even the the most visionary among us have been somewhat surprised at the speed with which the new technologies required for such services and the new services themselves are being implemented. This paper will focus on the technological progress that can be expected during 1991 with respect to the specific service offerings mentioned above.

Mobile Satellite Communications

With the launch in late 1990 of the first of the new generation Inmarsat satellites, and the decision by the Inmarsat Council to better cover the globe through the creation of a fourth ocean region, Inmarsat's space resources can now effectively be used for aeronautical, maritime, and land-mobile communications on a global basis. The remaining constraints on these services are no longer technical but regulatory, e.g. restrictions on the use of Inmarsat resources for domestic land mobile and fixed services in the US and Canada, among others. Technologically, however, the second-generation satellites can support low-cost messaging terminals such as the Inmarsat Standard C or derivatives of Standard C, and low-cost, compact voice and data/fax terminals nominally operating at 4800 bps (Standard M). Large-scale implementation of the new low-gain aeronautical data and high-gain aeronautical voice services will also begin in 1991, providing airline passengers with global communications aboard aircraft.

Current information has typical Inmarsat aeronautical terminals at prices well over US$100,000, Inmarsat Standard C messaging terminals at considerably over $5,000, and Inmarsat Standard M terminals at over $8,500. At these levels, such communications devices are primarily the province of commercial and specialized high-value applications, e.g., emergency, police, village telephony. For consumer or mass applications, however, it is estimated that current terminal prices would need to be reduced by factors of two to four if they are to appeal to a broader marketplace.

Achieving cost reductions of such a magnitude would necessarily require considerably higher production volumes in order to realize manufacturing economies of scale. The above prices, on the other hand, are typical of manufacturers who are assuming production runs in the low thousands of units. Given that no organization, to our knowledge, has yet been willing to commit to the purchase of such terminals in lots of hundreds of thousands, manufacturers have so far been unable to benefit from the kinds of economies already enjoyed by the makers of digital cellular telephones and other consumer products.

The above prices also reflect the relatively high component costs of the digital signal processors needed to implement the voice compression algorithms and sophisticated modulation and coding techniques which are essential to use of very small antennas and/or conservation of spacecraft power. Fortunately, however, these same processors will be the basis for implementation of the new digital cellular telephone standards in both North America and Europe. Thus, should mobile satellite terminals be manufactured by cellular telephone manufacturers, the potential exists for significantly lower component costs for the digital baseband functions through economies of scale with respect to the processors.

For example, Motorola, Analog Devices, AT&T, and Texas Instruments have all announced new-generation digital signal processors capable of 20-40 million instructions per second (MIPS). Available for high volume production in the middle of 1991, these devices will sell at prices in the range of US$30-$50 when purchased in quantities of hundreds of thousands--as would be expected for digital cellular telephones. Just 12 months ago, implementation of the modem and forward error correction functions for the Inmarsat aeronautical terminal required at least three digital signal processors, each costing over $100 in small quantities. It seems reasonable that this same technology could be applied using two of the new processors, at approximately US$30 each (if one is already buying the DSP's in large quantities to support the manufacture of digital cellular phones). This difference alone--some $200 in parts--is usually multiplied by a factor of three or more by the time it is sold to the end user, i.e, after all of the overheads and distribution and sales mark-ups are compounded. Thus, DSP savings alone could translate to an end-user savings of over $600 in mobile satellite terminal pricing!

On the radio side of the terminal, the subscriber unit manufacturer is somewhat at the mercy of the spacecraft designer and the service provider. Inmarsat Standard M terminals, for example, have very stringent radio specifications, require a costly high-performance diplexer, and use power amplifiers that put out at least 20 watts. Significant cost savings could be realized if specifications could be relaxed in a variety of dimensions, and in particular, if power-amplifier powers could be reduced by an order of magnitude or more. Such, in fact, is the case in the upcoming Australian land mobile satellite system where power amplifiers of approximately 2 watts will be used. This is possible because the satellite beam does not have to cover an entire hemisphere, but just the Australian continent. Similar savings will be realized with spot-beam satellites planned by Inmarsat for their third generation, and by others worldwide, such as the American Mobile Satellite Consortium and Telesat Mobile, Inc.

If cost is critical to making a technology ubiquitous, one might ask why the world telecommunications community hasn't done a better job in devolving satellite designs and planned service offerings from one fundamental principle: absolute minimization of the cost of a subscriber unit. Such a methodology, in fact, was successfully used in the design of the shirt-pocket CT2 telephone currently being implemented in the United Kingdom. The entire architecture of CT2 was predicated on the goal of keeping the cost of the subscriber unit to the absolute minimum, and CT2 prices are considerably below corresponding cellular telephone prices. It is true, however, that CT2 is not extremely efficient with respect to spectrum, but that was certainly one of the trade-offs made in favor of the low-cost subscriber unit. I submit that world organizations and government agencies should devote considerably more attention to next-generation offerings (beginning in 1994) from the perspective of achieving minimal subscriber unit costs.

A related issue involves the antenna technology. Mobile satellite services planned for 1991 will require antenna gains of between 0 and 3 dBi for messaging services and 12 to 15 dBi for voice, data and facsimile services. These high gain antennas need to be steered for mobile applications and, in the relatively small quantities being considered, represent the most costly components in the overall earth station. In spite of extraordinary efforts in antenna design R&D over the past few years (by Inmarsat, NASA and the Jet Propulsion Laboratory, among others) high gain, steerable L-band antennas are still extremely expensive. This is clearly an area deserving of continued research and perhaps a commitment by certain organizations to guarantee manufacturers the volumes of such antennas needed to achieve potential economies of scale. Although less sophisticated, the relatively flat receive-only Ku-band antennas used in television applications have realized just such economies.

For fixed-site applications, steerability is not a requirement. It is possible, therefore, to achieve very high gains at L band with fixed structures, thereby making it possible to develop and manufacture fixed-site telephony, data and facsimile terminals at selling prices a factor of two or better below those quoted above. The price argument improves even further with satellites designed to permit the use of smaller power amplifiers.

Over the past six months, a number of innovative satellite systems have been proposed using low earth orbiting satellites to achieve global coverage as well as very low-cost subscriber units. Although Motorola's Iridium system has received the most press coverage, several other systems have also been proposed. Such constellations of low orbiting satellites should help reduce both the power and antenna gain required in the subscriber unit with concomitant reductions in end-user cost. Whether the choice of system architectures might further reduce the cost of subscriber units remains to be seen. While such systems should be the most successful at minimizing subscriber unit costs, infrastructure costs for constellations of satellites will be enormous. And, given the inherently global nature of the low earth orbit concept, issues of sovereignty and regulation will need to be settled before such networks can be implemented. But, with a well-designed low earth orbiting constellation system, the possibility of mobile satellite subscriber units at prices near those for cellular telephones should be nearly within reach. The real question will be whether such constellations have sufficient capacity and/or can lower the cost per call-minute sufficiently to stimulate the kind of user demand that would warrant their construction.

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One indicator of the trend in prices for mobile satellite terminals to support voice, facsimile and data may be the price at which land mobile terminals go on the market in Australia in support of their land mobile satellite system which should be in operation in 1992. Target prices for each mobile satellite terminal were originally set at $A5,000. User acceptance of the severely compressed digital voice also remains to be seen. Though very good for its nominal 4800 bps data rate, the perceived quality at this compression level is certainly well below the 32 kbps ADPCM or 64 kbps PCM in common use for voice telephony.

Digital Cellular Telephony and Personal Communication Networks

Initial digital cellular telephone systems will be implemented in late 1991 in both Europe and North America. The European community has chosen the so called GSM (Groupe Speciale Mobile) standard which uses time division multiple access (TDMA) technology, digital voice compression nominally at 13 kbps, and a constant envelope modulation scheme called GMSK (gaussian minimum shift key) permitting use of relatively low-cost power amplifiers. The North American standard, as proposed by the Telephone Industry Association (TIA), also uses TDMA as the multiple access method (but at a burst rate several factors lower than the European standard), digital voice compression at 8 kbps, and a linear modulation scheme similar to that used in many satellite systems called QPSK (quadrature phase shift key). This modulation scheme does require amplifiers with better linearity characteristics than are needed for the current analog system. Both systems will implement techniques to mitigate fading from a variety of mechanisms typically encountered in the mobile environment, and software is being developed to better accommodate cell hand-offs and roaming, thereby making the systems more attractive to consumers.

The primary force driving development of the new digital systems, however, was the need for increased capacity to accommodate the explosive growth in this marketplace. Certain techniques will be overlaid upon the GSM system to permit it to operate quite effectively with cell radii small enough to accommodate user densities associated with personal communications, albeit the technology will be used at a higher frequency than is usual for mobile communications. Within the last year, a number of carriers or potential carriers of both cellular telephone services and personal communications networks in the United States have committed to experimentation with spread spectrum technologies to assess whether such technologies can provide even higher densities of users per cell and/or operate in coexistence with other current radio-based services.

Because the digital implementations will provide greater capacity to help satisfy the increased demand for cellular telephony, they should eventually result in decreased monthly costs for subscribers, thereby contributing to even more growth in subscribers. Initially, however, subscriber units that support both digital and current analog technologies (so-called dual-mode phones) are likely to be more expensive than their analog counterparts due to the increased processing requirements to accommodate voice compression, modulation, coding, and equalization techniques. It is estimated that the North American TIA standard, for example, requires at least 15 MIPS of processing power to implement the voice compression algorithm, and perhaps as much as an additional 20 MIPS for the modulation, coding and equalization. Thus, in the beginning, it is likely that two new-generation digital signal processors, as discussed previously, will be required in addition to the components already necessary for the analog mode. Moreover, since the TIA standard requires radio modules with somewhat more linearity than required for the analog mode, it is likely that the power amplifiers will also be somewhat more costly. Independent of the ultimate end-user prices (various forms of subsidization are typical in the US) the actual parts cost to manufacturers of dual-mode phones will likely be as much as 50 percent greater than for single-mode analog phones.

In time, however, manufacturers will integrate the analog functions into the digital processors along with a variety of user features which are now quite costly to consumers. Specific candidates for integration include: acoustic echo cancellation for hands-free operation in vehicle, noise reduction, and even voice recognition for voice command dialing. At the same time, further advances in the digital signal processors can be expected to reduce the number of components in the telephones such that subscribers will get enhanced-feature phones for about the same price as the current mature analog phones.

Beyond operating features, however, users of the new dual-mode phones will enjoy one other major advantage--talk time. Specifically, due to the time division multiple access nature of the scheme (i.e., the power amplifier is only transmitting a certain percentage of the time), all digital telephones will have longer talk times than their analog competitors. We currently estimate that, using the most current digital signal processors, subscriber units for initial systems could have at least twice the talk time. Alternatively, it is certainly possible that, instead of increasing the talk time over the current analog phone, one could reduce the battery pack capacity, resulting in a much lighter and more compact package than current analog units. Finally, digital cellular systems by their very nature will also permit better security and/or privacy for users.

An important consideration for Pacific Rim nations is that, with the migration from analog to digital cellular, infrastructure costs should also decline. Combining the increased capacity with decreased capital infrastructure costs for digital systems augurs well for provision of low-cost wireless communications in both industrialized and emerging nations. Furthermore, the digital cellular architectures being considered can also permit on-demand high speed digital data transmission, albeit on a circuit switched basis. It is therefore conceivable that cellular infrastructures will become the basis for integrated voice, data, facsimile and image transmission in a very natural evolutionary manner.

Over the past year, given the plethora of different technological approaches to mobile voice communications that have emerged, the industry is now considering three different types of mobile communication services depending upon the speed of the user: a mobile system which requires adequate performance at speeds of 90 km/hr (55 mph) or more; a pedestrian service accommodating speeds of approximately 10 km/hr (6 mph)--unless sprinters feel a compulsion to communicate while running; and fixed-site (stationary) applications. Each regime has a separate set of technical problems that need to be overcome with concomitant cost implications for subscriber units. Furthermore, fixed site applications generally will not require roaming provisions and pedestrian applications may not require national type roaming protocols. It is clear that the success of these services may be highly dependent upon the culture of the nation implementing the infrastructure. For example, in a nation with limited motor vehicle use, an infrastructure customized for pedestrian and fixed site application may be the most practical approach. Conversely, highly mobile industrialized nations may wish to integrate such pedestrian and residential service into a high-speed mobile infrastructure. Several of the Bell Operating Companies in the United States, for example, are experimenting with a spread spectrum technology which may be appropriate for both mobile and pedestrian application.

In 1991, a number of US experimenters will be evaluating a variety of PCN technologies that may be applicable to the residential fixed-site and pedestrian environments. The key objective here is the establishment of a service which identifies a subscriber unit with each individual, the so-called personal ID. Such a service would permit calls to be received wherever the individual is, without prior knowledge of geographic location. It is expected that initial PCN services will also begin in the United Kingdom in 1991, although most nations are awaiting the 1992 WARC to determine what specific spectrum will be allocated on a worldwide or regional basis for such services.

Spectrum allocation is a crucial concern in PCN as fixed-site and pedestrian services could require capacities of tens to hundreds of thousands of users per square mile. Such capacity could translate into a requirement for 50-100 MHz or more of bandwidth, a number considerably larger than that available for most mobile services. Also, cell sites will have to become quite small to permit a reduction in the cost of the subscriber units and to permit accommodation of the integrated demand. It is estimated, for example, that some 10,000 microcells would be required to build out the city of Tokyo and 2,000-5,000 to cover New York City. Where cellular telephones range from 0.6 watts for handhelds to 6 watts for mobiles, PCN subscriber units will vary from 50 milliwatts to 500 milliwatts, depending on the technologies used and cell site radii. Frequencies under serious consideration worldwide are in the 1.7 - 2.6 GHz range, a frequency band primarily used for point-to-point as opposed to mobile applications. Serious investigations are now under way of the propagation and in-building penetration characteristics of these frequencies.

In the United States, a number of manufacturers are experimenting with sets of bands associated with so-called "Part 15" operation. Three bands permit relatively high power transmissions if spread spectrum technology is used without the licensing of individual subscriber units: the 902-928 MHz band; the 2.400-2.483 GHz band; and the 5.725-5.875 GHz band. Others will be experimenting in the 1850-1990 MHz band currently used by utilities, police and others for point-to-point microwave, to see if spread spectrum technologies can coexist with these services.

In Japan, it is likely that a primarily fixed-site service may be implemented prior to true PCN. The MOPT in Japan has proposed a draft concept for a second-generation digital cordless telephone which may use time division multiple access (with time division duplex or ping-ponging) and modulation schemes similar to either the European or US digital cellular standards. Frequencies between 2.1 and 2.6 GHz are being considered with channel burst rates in the hundreds of kbps thereby allowing on-demand access to 2B+D or 144 kbps type ISDN capabilities. Approximately 50 different manufacturers have either developed or are developing experimental equipment for this form of digital cordless telephone. Recommendations and standards following these experiments are expected by mid-1991. Given that the emphasis will be on low-cost subscriber units, it is unlikely that the technology chosen will be appropriate for high-speed mobile applications. The technology being investigated is similar in concept to that being proposed in Europe for the Digital European Cordless Telephone standard, so called DECT.

We submit here that these new-generation digital cordless telephone technologies may offer the best compromise for developing nations that wish primarily fixed-site and pedestrian wireless infrastructures to support low-cost subscriber units. Cell sites will also be compact and inexpensive, given the tremendous numbers of them required to cover a city. Very high data rates will be possible on demand; security will be possible through the digital nature of the transmission; and voice quality will probably be better than provided by either the European or North American digital cellular standards, e.g. 32 kbps ADPCM or a 16 kbps equivalent. Current cost targets are for digital cordless telephone subscriber units to be at least half the cost of a cellular telephone.

To accommodate the anticipated high densities of users and coordinate the large number of cell sites, very high capacity digital switches will also have to be developed. But such switches make very natural gateways for long-haul communications, either by terrestrial or satellite means.

If the world community could indeed agree upon a common frequency band for either PCN or digital cordless telephony, and if a consensus could be forged on an international standard for the technology, one could envision a true global personal communications device which would operate anywhere internationally. Since there are already multiple standards for analog cellular telephones and at least three different standards emerging for the new-generation digital cellular telephone, immediate consideration should be given to development of a world standard for either PCN or digital cordless telephony. The ideal, of course, would be a world standard with common frequencies, so that a subscriber unit used in one nation could be used in any other nation. 1991 will therefore be an important year for the world community to formulate its position with respect to PCN in preparation for the 1992 WARC.

Mobile Data Communications and Personal Communicators

At the present time, mobile data communications networks exist in a large number of countries serving a diverse user community. Mobile data serves the military, police, emergency services, taxicab and transportation industries, field service and sales organizations, utilities and even gambling/gaming industries. It is possible that the use of mobile data terminals in non-western countries has been limited due to the difficulty of transmitting Kanji or pictorial type scripts, but these limitations in graphics are being overcome technologically at the present. Most mobile data infrastructures have one major advantage over cellular infrastructures in that they are designed to broadcast common information to a number of users for so-called dispatch applications. Additionally, most of the sophisticated mobile data infrastructures are inherently packet oriented, which means that messages can find their ways to addressees through the equivalent of a personal ID, as opposed to requiring prior knowledge of a geographical location. Modern packet mobile data networks very efficiently use spectrum and are optimized for messages as opposed to file-transfer applications. In addition to their personal ID features, they also have such niceties as message store and forward facilities with assurance of guaranteed message delivery.

1991 will see implementation of a multitude of new and sophisticated mobile data networks. IBM and Motorola will be continuing the roll-out of their ARDIS offering in the United States while RAM Mobile Data and its affiliates, utilizing infrastructure technology developed by LM Ericsson, will be implementing networks in the United States and the United Kingdom. Similar technology is being implemented in Canada, other countries on the European continent, and in several countries on the Pacific Rim. These networks operate over special mobile radio or private mobile radio channels; networks implemented in 1991 will use either 900 MHz allocations in the US and Canada or 400 MHz allocations in Europe and Pacific Rim countries. Other frequencies are possible on a country-by-country basis.

Although mobile data terminals are currently quite expensive, even when compared to cellular telephones, the subscriber unit technology is, in fact, less complex than any of the digital cellular technologies being considered. This implies that if applications could be found for messaging that could provide economies of scale similar to cellular telephones, mobile data units could be made more cheaply than cellular telephones and might even offer certain advantages over voice competitors, namely: (i) guaranteed message delivery, (ii) inherent personal ID nature of communications, (iii) improved building penetration, (iv) ability to broadcast messages to specific groups of users, and, (v) support of non-messaging wireless applications which are essentially bursty in nature, e.g, point-of-sale and SCADA.

With respect to the latter, such network infrastructures could certainly support wireless point-of-sale and transactional processing terminals, SCADA supervisory control, and data acquisition applications such as meter reading, resource management, sensor data, etc. Two applications that are natural extensions of such sophisticated infrastructures include acknowledgement paging and personal electronic messaging.

With proper cell site engineering, very low-cost, compact, two-way mobile communications devices should be feasible. In fact, such technologies and services could be demonstrated late in 1991. One new paging concept provides for a positive acknowledgement to be generated from the recipient's terminal to the sender whenever a message or page is received and read. Obviously, such an application could offer serious competition to current data paging operations. Attaching a keyboard or other I/O device to the personal mobile data terminal could provide the equivalent of a two-way electronic messaging personal communicator. Moreover, a variety of value-added services could also be implemented to further broaden the appeal of these low-cost subscriber units and their infrastructures.

Perhaps most exciting, however, is that the mobile data infrastructures planned for implementation in 1991 readily expand through their packet nature to accommodate international communications. Messages could be sent to specific addressees with guaranteed delivery independent of knowledge of the addressee's location--anywhere in the world where the network existed. We submit that equivalent capability for cellular telephony or PCN is many years distant compared to the capability inherent in networks being installed next year for mobile data communications.

Summary

1991 will indeed be a pivotal year in the history of personal communications. New technologies are being implemented and new standards implemented. New generation digital signal processors are now being delivered which should permit implementation of sophisticated new technologies at low cost. The world community is preparing for a 1992 WARC to discuss the allocation of spectrum for personal communications services. Many new technologies are being implemented and tested, all addressing a common goal: ubiquitous personal communications at the global level.

Unfortunately, most of the technologies being assessed are incompatible with each other, and there does not yet seem to be a clarion call for international standards, either in technology or in spectrum. Such a call by an influential member of the world communications community would have a two-fold ameliorative impact: (i) it could offer to manufacturers unprecedented economies of scale at the international level, thereby putting these technologies within reach of consumers worldwide, and, (ii) it could ultimately lead to a global standard, permitting use of individual personal-communications devices anywhere in the global community.

It is absolutely clear that the technological wherewithal exists to accomplish the above two objectives in the very near term. It is also very clear that national and regional self-interest and manufacturing protectionism continue to militate against the creation of such international standards and allocations. It may be that innovative commercial systems developed by individual manufacturers will, of necessity, become de facto standards in the absence of formal agreements. Perhaps systems such as the one proposed by Motorola in mobile satellite communications or the L.M. Ericsson/Swedish Telecom Mobitex mobile data system can become such standards in fact. Both systems can provide global communications and the Mobitex system's open architecture is such that any manufacturer can build subscriber units (it remains to be seen whether the Iridium system will have such an open architecture). Inasmuch as the global community failed to issue a single standard for the newest generation of cellular telephone, we must seize the moment to consider implementing such a global standard for new-generation personal communication and digital cordless telephone devices, lest this opportunity, too, be lost.

It should be clear that most of the infrastructures discussed above not only support personal communications, but can also support varieties of other services needed in both industrial and developing nations. By the end of 1991, we should all have a better idea of which of the technologies and architectures are best suited for the telecommunication challenges facing each of us for the remainder of the decade.

THE FUTURE OF CELLULAR TECHNOLOGY IS HAPPENING TODAY IN HONG KONG

Robert S. Young

Director Asia/Pacific Operations
International Cellular Infrastructure Division, Motorola Inc.

In a British Territory of a mere 400 square miles , the combination of cellular communication technology and the highest population density on earth have resulted in a peerless "living laboratory" for cellular system marketing, engineering and planning.

As host to six million people -- 115,000 of them cellular subscribers, Hong Kong is our "living lab." The presence of nearly every existing form of design and unfolding advancement have created a singular opportunity for everyone involved in cellular technology to watch and learn.

By studying this special market, we can relate to circumstances that might be encountered as our own systems become more heavily populated.

Hong Kong will also provide us with the opportunity to acquire an early understanding of some of the issues that will arise as emerging technologies such as PCN come to light. PCN will bring cell sites within .5km to even .25km of one another in complex physical settings -- for which Hong Kong will provide an ideal testing ground.

Indeed, cellular operators and engineers in Hong Kong will be formulating answers to the very problems we may encounter as our systems grow and as we begin to implement technologies such as PCN.

How did Hong Kong become this "living lab?" They didn't win the title through a bid or a contest -- the high population density and the ways in which the people of Hong Kong work and live were the determining factors.

Two thirds of Hong Kong's entire population resides in a region smaller than Manhattan. As many as 200,000 people live within a single square mile. Within that mile is an average of 3,500 portable cellular subscribers -- The highest proportion of portable cellular subscribers in the world. The ratio of portable versus mobile (car) users in Hong Kong is greater than 5:1. During the past 12 months Hong Kong's cellular market has achieved a growth rate of 56%.

The extraordinary population and user density alone however, do not begin to define the challenge facing Hong Kong's operators and engineers.

Of all the major markets, Hong Kong demands the highest amount of frequency re-use. Their sectorized cell sites are in closer proximity than in any other market, some a mere 650 meters apart, and each carries 30 erlangs per square kilometer.

Hong Kong's RF environment is among the world's most inhospitable. Some of the contributing elements are: numerous skyscrapers of metallized glass, concrete and steel; extensive tunnels; a downtown airport; a harbor that bisects the most urbanized areas, Hong Kong Island and Kowloon; and a terrain of approximately 70% mountains. These and countless potential sources of RF interference could qualify Hong Kong as a cellular system engineer's true nightmare.

As in the United States, the competition for cellular services is hot. Hong Kong's cellular services are provided by three directly competing private operators, Communications Services Limited, Pacific Link and Hutchison Telephone Company Limited. The market is driven by very steep customer requirements. High quality connections, continuous access, international roaming and a low percentage of dropped calls are all priorities defined by the customers.

Users of portable phones generally have higher expectations for service and performance of their phones than do mobile phone users. Portable users attempt calls from all locations, all heights. They tend to use their phones for more important reasons such as business transactions, and use them more frequently (though for shorter durations), during more hours of the day than their mobile counterparts. The customer's fundamental expectation is portable phone convenience with wire-line quality. A tall order in a relatively uncomplicated environment. Hong Kong, perhaps, is the ultimate challenge. According to Bruce Hicks, manager of network operations at Hutchison Telephone Company, "customers expect us to respond to their requirements, regardless of extenuating circumstances."

Motorola has taken part in system planning in dozens of markets around the world. In a typical market, systems are installed and left alone until subscriber demands exceed the original projections. As portable phones gain popularity, the average life of a system will continue to decrease at an accelerated pace. In a typical situation, a system expected to last five years may be out-grown in two or three years. In Hong Kong's case, however, a system design may last only a few short months.

Designing a system in Hong Kong is a highly-strategic, never ending process. Each time a new subscriber signs on, changes can entail relocation/redirection of antennae, cell moves, adjustments in power level, or any combination thereof. Every change entails yet another change, and it all must be done very quickly so that service quality remains high and growth uninterrupted. The learning curve is steep, the going slow and mistakes expensive.

Controlling growth without sacrificing level of service is critical. One of the three private operators, Hutchison Telephone Limited, reached its "capacity" twice, in 1988, for three months, and again in 1989. During these periods the company stopped signing new subscribers for weeks while the system was redesigned to accomodate additional users without deterioration of quality for the current subscribers.

The strongest signal available is normally achieved by blasting the signal deep into ground floor offices or through tunnels. Dense cell patterns are achieved only by transmission of a weak signal, which avoids interference. Cellular operators and engineers in Hong Kong attempt what seems to be the impossible: strong but disciplined signals that virtually stop on a dime and go only where they are told.

Hong Kong's wide array of reflective surfaces often results in bizarre frequency patterns. The ability to track frequency patterns is an invaluable tool for troubleshooting. Hutchison has been able to take much of the guesswork out of system design by implementing a SAFCO instrument, the only one of its kind operating in Hong Kong. The SAFCO system enables Hutchison to monitor up to 60 radio channels at a time. The radio signal occurrences are recorded and overlayed on a digitized map of Hong Kong. The resulting computer print-out shows signal quality, which allows Hutchison to spot potential problems, before they become real customer problems.

The system also allows Hutchison to live-test transmitters and receivers, adjust power levels, make temporary relocations of antennae and perform a variety of other experiments. They are now able to establish effectiveness prior to acquiring real estate or setting up new cell sites. Hutchison is now able to plan for maximum density without sacrificing quality.

Cell sites and antennae are most often located on the tops or sides of offices, suites or privately owned buildings. Buildings may not have suitable (strong, flat) roofs, or may have billboards, water tanks or other obstructions. One Hong Kong cellular systems planner likens the addition of new cells to "tossing boulders into a pond -- ripples upon ripples." Changing just one cell site may entail the installation of 2-3 additional sites to compensate for the loss of that "ideal" location.

Finding the perfect site with a map and engineering data is not particularly difficult. However, the reality may be that the owner of the building is unwilling to accommodate, or the site has already been taken by a competitor. If that ideal site is not available, you may be headed back to the drawing board to completely redesign the system.

The related issue of property rental is of escalating importance. Space for a single antenna can cost hundreds of dollars each month, and in Hong Kong, multiple antennae are required for each system. As portable use increases in the business districts and the systems become more heavily focused, the monetary value of rental spaces will continue to increase as possible locations are depleted.

Operators in primarily urban markets must consider the physical size of the cells, antennae height, and aesthetics, not just engineering characteristics. Taking these elements into consideration during the product development may mean the operator/engineer can make use of locations which would not have been feasible with earlier, more cumbersome equipment.

Another problem operators and engineers face with the expansion of system capacity is bandwidth. Because there is no auxiliary bandwidth available, the challenge becomes one of creativity -- how to stretch, bend and re-use frequencies.

An often-used technique, powering the base station to control interference, is effective in open, flat environments. This, obviously, is not an option in Hong Kong. Power and frequency control planning are used before considering lower base station power. Such a strategy provides for the best in-building penetration by providing a balanced receive-transmit path while keeping subscribers at the lowest effective power level needed.

The battle today does not just come down to operator versus operator. It has shifted to the streets and rooftops. The operators' strongest opponents are geography, physical constraints and the finite RF spectrum. Who will find the most creative ways to stretch and bend frequency? Which company will make and keep the commitments to quality and customer requirements?

We, in the meantime, can watch as case histories develop, as Hong Kong operators and engineers encounter and struggle with new and more complicated challenges. If we make the best of this gift of looking into the "cellular future" as it happens, we will have the solutions and insights to many of the issues without ever owning the problems. And we will be able to implement, come up to speed and grow beyond the newest technologies more efficiently and effectively than ever before.

MOBILE & INTELLIGENT NETWORKS

ANTHONY P. SETCHELL and NIGEL DEIGHTON
DIGITAL EQUIPMENT CORPORATION
GENEVA, SWITZERLAND

ABSTRACT

The successful operation of digital mobile networks such as Group Speciale Mobile (GSM) and hand portable networks such as Personal Communications Networks (PCN) will require network infrastructures able to perform authorization checks, generate encryption keys and billing records, manage a greatly increased rate of call hand-off and offer advanced services in a cost effective and efficient manner.
This paper shows how Intelligent Network products, systems and services can be applied to these problems.

The successful operation of digital mobile networks such as Group Speciale Mobile (GSM) and hand portable networks such as Personal Communications Networks (PCN) will require network infrastructures able to perform authorization checks, generate encryption keys and billing records, manage a greatly increased rate of call hand-off and offer advanced services in a cost effective and efficient manner.

I'd like to share with you today how Digital Equipment Corporation perceives its Intelligent Network Products, systems and services can be applied to these problems.

We consider that mobile communications and the evolving IN concepts are complementary. Today's Service Control Points (SCP) are high speed, high availability network wide database servers. Within the context of public switched telephony networks SCPs are already delivering services such as 800# and credit card calling. In the future such SCPs will deliver multiple services from the same platform.

Within the mobile context, database applications such as Home Location Register (HLR), Visitors Location Register (VLR), Authentication (AUC) and Equipment Identity Register are required to support roaming.

We believe that these database applications and others relating to new services which will be offered on digital mobile networks and personal communications networks, can be developed upon Intelligent Network SCPs. Such concepts are not limited to the new digital mobile communications networks, at least two major European analogue network operators are considering retro-fitting 'GSM like' HLR and Authentication registers into their networks.

The use of real-time processing systems such as SCP is not limited to large stand-alone database. Computer systems can be connected as adjunct processors to enhance existing switch functionality by providing billing data collection, billing record verification as well as local services.

However they are deployed, service delivery platforms must be managed by a service management infrastructure adapted to the specific requirements and operational environment of the network operator.

INTELLIGENT NETWORKS AND MOBILE COMMUNICATIONS

General purpose Computing will provide solutions to facilitate the creation, management and provision of new services in the most open and switch independent manner possible.

Specifically Intelligent Networks provides a cost-effective means of evolving the existing network architecture to simplify and accelerate new service introduction at local, regional, national and international levels.

Within the context of existing PSTNs, Intelligent Networks is viewed as an architecture for managing change and cost reducing the service development and deployment cycles. This is achieved by rendering the service domain independent of the connectivity or switching domain via appropriate functional modeling and interface definition.

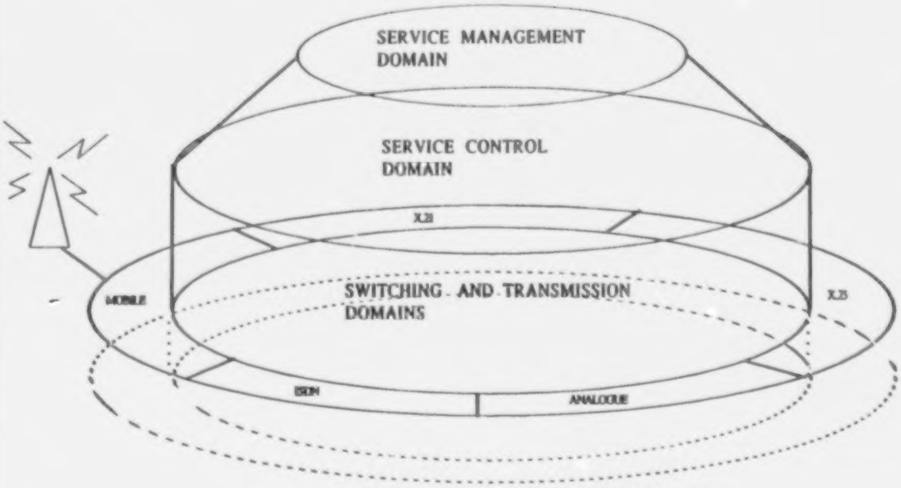
SLIDE 2 - DOMAIN ARCHITECTURE

Intelligent Networks, at first sight, may not be considered applicable to the operational problems of mobile network operators. However, one of the major goals of the mobile industry is to offer roaming at the local, regional, national and international levels. Roaming is predominantly a problem of subscriber hand-off between Mobile Switching Centers, which control a group of cells or base stations. Within a single operator common procedures can be established. When handling a call off to a different operator (which would be needed for national or international roaming) then differences in procedures, protocols etc., need to be catered for. Accounting information exchange between two or more operators for billing and revenue splitting must also be addressed when considering roaming. Additionally there is the need, identical to that facing PSTN operators, to develop and deploy advanced services.

SLIDE 2

DOMAIN ARCHITECTURE

MOB_01



SERVICE MANAGEMENT DOMAIN

SERVICE CONTROL DOMAIN

X.25

MOBILE

SWITCHING AND TRANSMISSION DOMAINS

X.25

ISDN

ANALOGUE

FUTURE SWITCHING AND TRANSMISSION DOMAINS (IE BROAD BAND ISDN)

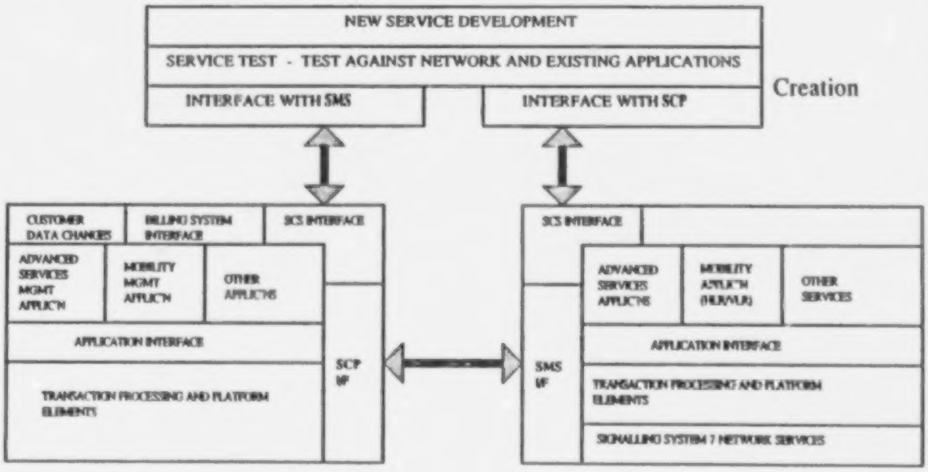
6 FEBRUARY [illegible]

N Deighton TSO VALBONNE

SLIDE 3

FUNCTIONAL MODEL

MOB_01



NEW SERVICE DEVELOPMENT

SERVICE TEST - TEST AGAINST NETWORK AND EXISTING APPLICATIONS

INTERFACE WITH SMS

INTERFACE WITH SCP

Creation

CUSTOMER DATA CHANGES

BILLING SYSTEM INTERFACE

SCS INTERFACE

ADVANCED SERVICES MGMT APPLIC'N

MOBILITY MGMT APPLIC'N

OTHER APPLIC'NS

APPLICATION INTERFACE

TRANSACTION PROCESSING AND PLATFORM ELEMENTS

SCP I/F

SMS I/F

SCS INTERFACE

ADVANCED SERVICES APPLIC'NS

MOBILITY APPLIC'N (HLR/VLR)

OTHER SERVICES

APPLICATION INTERFACE

TRANSACTION PROCESSING AND PLATFORM ELEMENTS

SIGNALLING SYSTEM 7 NETWORK SERVICES

Management

Service Delivery

Logical Interfaces and Functions

6 FEBRUARY [illegible]

N Deighton TSO VALBONNE

In Europe the GSM activities have concentrated upon developing standards for a pan-European mobile network. Effectively a network which offers international mobility, billing and advanced services.

Digital believes that the concepts developed with IN and the standards developed by GSM show considerable synergy and a combination of the two concepts will provide a significant competitive edge.

Our view of Intelligent Networks is:-

1. Intelligent Networks is a distributed approach to service delivery which protects investment in services against the evolution of connection domain technology, while maximizing the revenue potential of existing switching and connectivity domains.

2. IN Standards are being developed but it is unlikely that they will be implementable before the 1993-1995 timeframe. Therefore in the interim period some aspects of any vendor's solution will be proprietary.

3. Services provided by IN are effectively independent of the connectivity domain and thus could be provided across analogue and digital telephony networks, X.25, X.21, mobile and telex as well as any future broad-band mobile or broad-band ISDN networks.

4. Inand GSM concepts together can offer inter networks roaming and mobility management combined with the ability to rapidly deploy advanced mobile services.

5. Services are increasingly important and will benefit from IN infrastructures. GSM is essentially the first manifestation of IN in Europe. IN permits integration of services across fixed and mobile networks for those organizations operating both types of network.

6. Programmability is a vital part of successful implementation. We are working to provide an application programming interface and execution environment, based where possible on existing international standards, until specific IN standards become available. Digital realizes that a network operator's ability to develop its own services or to have them developed by third parties (e.g. software houses) is a crucial competitive advantage.

7. The Intelligent Network concepts of Service Management System (SMS) and Service Creation System (SCS) are equally valid within the mobile communications context for managing data within network databases and for developing and deploying advanced services.

8. The use of a Services Management System supporting interfaces to both computer based database servers and switch based database servers (i.e. Visitors Location Registers) will promote a unified management interface for network data resources and could support real-time traffic and statistics gathering for performance and load analyses.

Such layering as shown on this slide is indeed one of the keys to the future migration of a network.

By defining appropriate boundaries and interface definitions, for underlying transmission and switching fabrics, investment in services software is protected. An existing service can be made available on a new fabric by extending a relevant interface into the new fabric. For example IN services provided on an PSTN network can be made available on a mobile network. Services provided upon an analogue mobile network can be offered to a digital mobile network and later a broad-band mobile network or Personal Communications Network.

SLIDE 3 - FUNCTIONAL MODEL

Essentially the definition of boundaries and interfaces is an architecture for managing the growth and technological change which the Telecommunications Service Providers are undergoing and will continue to undergo at an increasing rate. IN renders the service independent of the technology within the switching and transmission fabric. New services can be easily added to the underlying connectivity domain or can be offered on multiple domains.

How the IN architecture is implemented is critical in determining whether services can be deployed and moved across CPUs as needed or whether they will need to be re-compiled or even re-written.

This slide shows a logical representation of the functions that need to be implemented to realize creation, management and delivery of services.

While the figure shows an interface between creation and delivery mechanisms this is meant to signify that creation and validation must take into consideration the management and delivery environments. In reality a management function would be used to deploy tested services into the delivery domain.

SLIDE 4 - GSM OVERVIEW

The following represents an overview of a GSM network:-

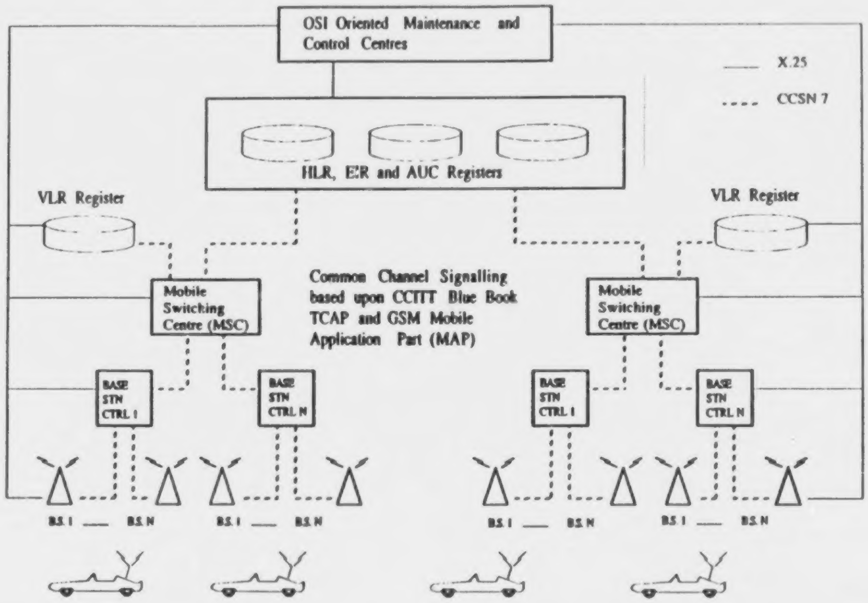
The network databases are shown:-

. **Visitors Location Register (VLR)**:- This database is collocated with the Mobile Switching Centers (MSC) and is accessed at each call. When a mobile roams into the area serviced by a base station connected to the MSC information, sent by the mobile, is used to identify the Home Location Register (HLR) of the subscriber. The VLR is updated with services and feature information from the HLR.

SLIDE 4

GSM OVERVIEW

MOB_02


OSI Oriented Maintenance and Control Centres
X.25
CCSN 7
HLR, EIR and AUC Registers
VLR Register
VLR Register
Mobile Switching Centre (MSC)
Mobile Switching Centre (MSC)
BASE STN CTRL 1
BASE STN CTRL N
BASE STN CTRL 1
BASE STN CTRL N
B.S. 1 — B.S. N
B.S. 1 — B.S. N
B.S. 1 — B.S. N
B.S. 1 — B.S. N

Common Channel Signalling based upon CCITT Blue Book TCAP and GSM Mobile Application Part (MAP)

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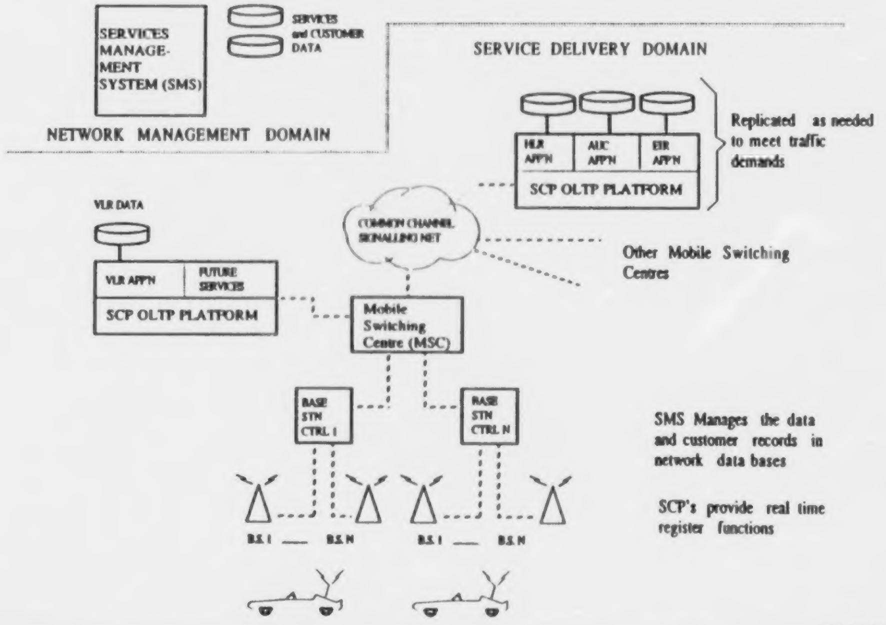
SLIDE 5

SCP as MOBILE REGISTER

MOB_05


SERVICES MANAGEMENT SYSTEM (SMS)
SERVICES and CUSTOMER DATA
NETWORK MANAGEMENT DOMAIN
SERVICE DELIVERY DOMAIN
HLR APPN
AUC APPN
EIR APPN
SCP OLTP PLATFORM
VLR DATA
VLR APPN
FUTURE SERVICES
SCP OLTP PLATFORM
COMMON CHANNEL SIGNALLING NET
Mobile Switching Centre (MSC)
BASE STN CTRL 1
BASE STN CTRL N
B.S. 1 — B.S. N
B.S. 1 — B.S. N

Replicated as needed to meet traffic demands

Other Mobile Switching Centres

SMS Manages the data and customer records in network data bases

SCP's provide real time register functions

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- **Home Location Register (HLR)**:- A database system which is shared amongst a number of MSCs (determined by network size, traffic and incremental growth characteristics). The function of the HLR is to track a roaming subscriber for delivery of incoming calls. When a roamer enters a new MSC area, the associated VLR requests subscriber and feature data from the HLR. The HLR records the new VLR identity and then cancels information held in the VLR previously responsible for the subscriber.

- **Authentication Centers (AUC)**:- Used within the GSM network to generate a key sets (triplets) needed to correctly encrypt the air traffic for privacy and security reasons.

- **Equipment Identify Register (EIR)**:- Ensures that the mobile equipment is from a valid manufacturer, is not stolen and is not black listed.

Such database systems must have the following generic requirements:-

- High availability
- High performance query/response processing
- High integrity
- Support real-time writing as well as reading (keep track of roamers)
- Support multiple or relational searches (i.e. HLR support for VLR crash recovery)
- Able to respond to predictable subscriber growth patterns (i.e. until **critical mass** is reached, growth is linear, then it enters a phase of geometric growth).

Service Control Point systems already in operation offering FREEPHONE and 'DIAL IT' services are successfully coping with npredictable growth patterns.

SLIDE 5 - SCP AS MOBILE REGISTER

This illustration considers the use of IN like Service Control Points as the various database registers within a mobile context.

The Intelligent Network concept of Services Management System (SMS) is shown as being part of the network management domain.

The diagram shows that new or advanced services could be added via the VLR system. Such services could also be integrated within the systems providing HLR, AUC or EIR services on general purpose SCPs or distributed over a combination of these.

The range and scope of advanced services would be dependent upon the messaging interface that would exist between the MSC and the SCP. For example, one could imagine an Intelligent Network Application Part (INAP) running above the signaling system 7 Transaction Capabilities Application Part (TCAP) in much the same way as the GSM Mobile Application Part (MAP) already does.

In terms of mobile call hand-off to another network, which may be using a proprietary hand-off protocol, one could consider a Service Control Point as a form of gateway or bridge managing the interface and performing suitable translations.

SLIDE 6 - CALL HANDOFF

The EIA/TIA 45.2 committee is developing the IS-41 standard for call hand-off. This could be implemented as an application within a Service Control Point. In order to achieve full roaming there would also need to be an exchange of accounting information between operators for billing purposes. Such an SCP application would provide the necessary information exchange between operators with differing accounting formats and mechanisms.

A subscriber roaming in North America would also require incoming calls to be directed to the cell which he is currently visiting. An application, similar to the GSM Home Location Register, could be developed which would allow the network operators being visited to accept subscriber and feature information from the roamer's home network. The application would take into account differences in the way the two networks represent such information, allowing the HLR to route incoming calls more efficiently.

SLIDE 7 - FUNCTIONAL MODEL

This diagram gives a more detailed view of what the functional blocks of a 'mobile supervision' SCP could look like.

The platform contains the following functional elements:-

- Communications Services to Register Data Management Systems, the interfaces to service management systems which are used to add subscribers, remove subscribers, attribute credit control information etc.

- Communications Services to Network Management Systems, the interfaces required to enable management of the underlying hardware and software as a network element.

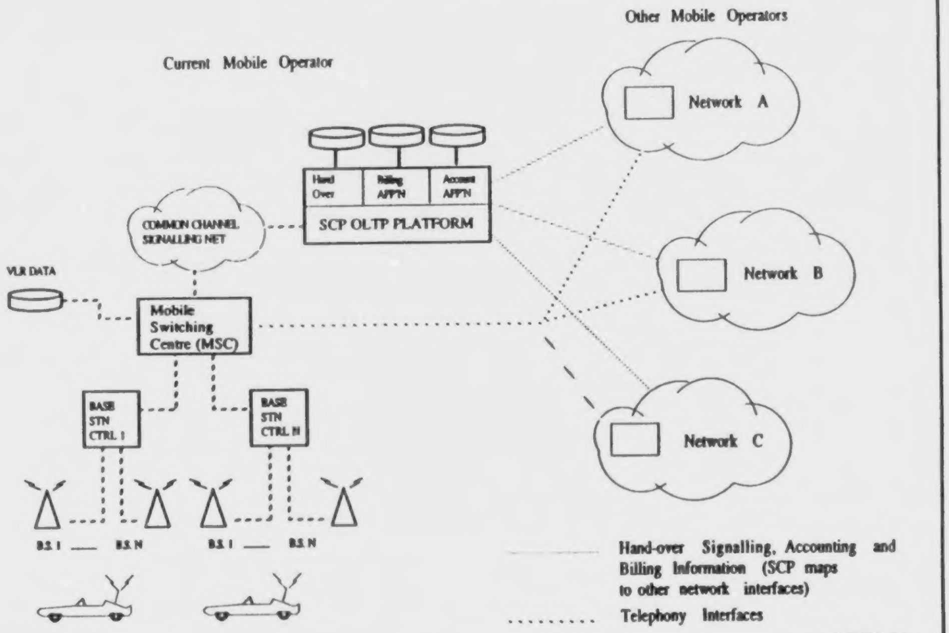
- Database Services refers to the normal query/response processing expected of a database performing routing, tracking and authorization activities. Additionally the database will record statistical information required for usage and exception reporting.

- Application Status Reports is a set of generic functions enabling applications to report management and statistical information to the services management systems.

- Database Updates, a function which accepts database updates from the management systems (i.e. addition of a new customer) and applies them to the real-time database.

CALL HAND-OFF

MOB_06


Other Mobile Operators
Current Mobile Operator
Network A
Network B
Network C
Hand Over
Billing APP'N
Account APP'N
SCP OLTP PLATFORM
COMMON CHANNEL SIGNALLING NET
VLR DATA
Mobile Switching Centre (MSC)
BASE STN CTRL 1
BASE STN CTRL N
B.S. 1 —— B.S. N
B.S. 1 —— B.S. N

—— Hand-over Signalling, Accounting and Billing Information (SCP maps to other network interfaces)

. . . . Telephony Interfaces

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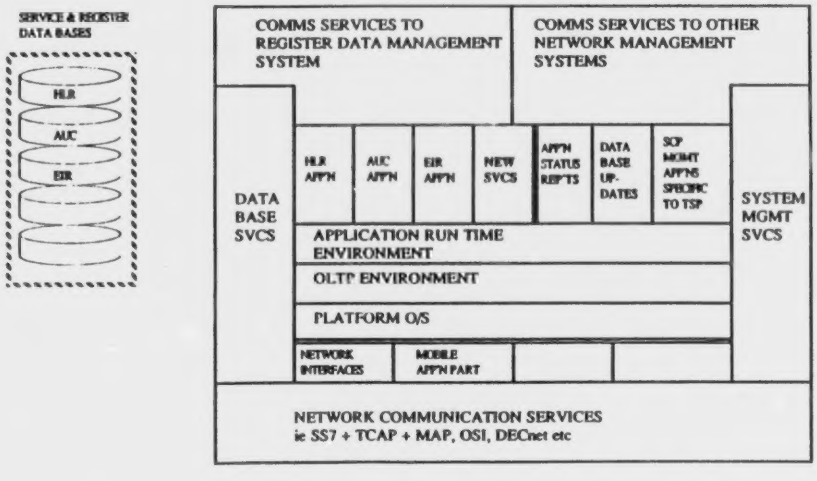
FUNCTIONAL MODEL

MOB_08


SERVICE & REGISTER DATA BASES
HLR
AUC
EIR
COMMS SERVICES TO REGISTER DATA MANAGEMENT SYSTEM
COMMS SERVICES TO OTHER NETWORK MANAGEMENT SYSTEMS
DATA BASE SVCS
HLR APP'N
AUC APP'N
EIR APP'N
NEW SVCS
APP'N STATUS REP'TS
DATA BASE UP-DATES
SCP MGMT APP'NS SPECIFIC TO TSP
SYSTEM MGMT SVCS
APPLICATION RUN TIME ENVIRONMENT
OLTP ENVIRONMENT
PLATFORM O/S
NETWORK INTERFACES
MOBILE APP'N PART
NETWORK COMMUNICATION SERVICES
ie SS7 + TCAP + MAP, OSI, DECnet etc

6 FEBRUARY 1990

- SCP Management application refers to the 'node software' required to ensure that the hardware, software and applications act as a single, coherent, network element.

- Application Runtime Environment refers to the environment within which services or applications run and the application programming interfaces to which they should adhere. It ensures that the applications are as independent as possible from the underlying system elements. Within the IN context a number of standardization activities are underway (e.g. ETS1 NA6 and CCITT) which will have bearing upon this area.

- The remaining elements represent the transaction processing, high availability platform which includes interfaces to the switching fabric such as signaling system 7.

The role of a mobile Services Management System would mainly be to manage the data used in real-time by the network. Such data would primarily relate to customer information such as billing address(es), services subscribed to, status, credit levels etc. By implication there would also be requirements for number management, allocation of subscribers to Home Location Registers and service management of any advanced services being offered on SCPs.

A multi-vendor SMS should be able to interface to service delivery platforms from other vendors, such as switch based database (i.e. VLR) and services applications. This will facilitate network operator staff training and also training of service providers (those who re-sell air time and connect customers to a network). Service providers require on-line access to administration systems to add new customers etc.

SLIDE 8 - MOBILE SERVICES FUNCTIONAL ELEMENTS

This diagram represents a functional view of a Services Management System:-

The functional elements referred to above are:-

- Network Operations Interface is used by the network operator to manage the services, customer records and report generation based upon statistics gathered from network elements (i.e. SCPs, switches etc.)

- Service Providers Communications Services refers to the on-line access mechanisms, such as X.25 and the relevant applications interfaces and presentation management which allows Air-Time re-sellers to add new customers etc. Security and access control functions are required to ensure only authorized agents are allowed access and they they can only effect changes on their own data.

- Various management applications which manage services within the network such as Home . . Location Registers, Authentication Centers and advanced services and gather relevant statistics.

- SMS Management application refers to the in-built 'node software' which controls the SMS hardware and software and ensures predictable and coherent operation.

- The remaining functional elements are much as those described for the SCP.

The addition of such service delivery platforms, with associated service and data management capabilities, would effectively offer a network migration path which would facilitate both interworking and hand-off between multiple networks as well as migration to industry and international standards as they emerge. The IN capabilities would also provide a mechanism for delivering advanced mobile services as needed.

In order to maintain products and architectures in line with industry directions, Digital participates in all the relevant standards bodies and industry forums.

Such international and industry standardization efforts are underway to define IN interface definitions in terms of what are called functional components (rather like a callable software library). These include CCITT, ETSI and the Bellcore sponsored multi-vendor interaction forum. In Europe there is widespread acceptance that the pan-European GSM architecture is an instance of an Intelligent Network.

SLIDE 9 - Application Interfaces

Currently the activities within ETSI and CCITT are in a start-up phase and activities to refine work plans and areas of standardization are underway. Schedules are being prepared where aggressive target dates are being discussed.

The Groups Special Mobile has been working within the CEPT and more recently ETSI, to develop a true pan-European standard for digital mobile communications. Work has been performed to solve the problems of accounting, billing, routing, hand-off and management within a multi-operator, multi-country environment. These standards are being implemented within the European mobile telecommunications networks and are planned to become operational in mid-1991.

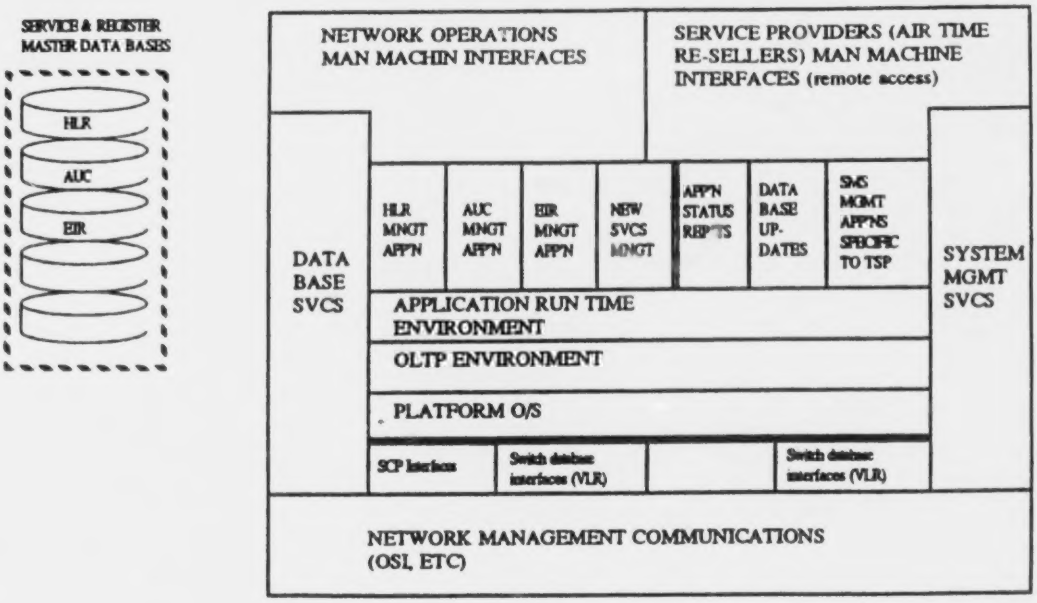
CCITT has also developed the DECT standard which, in conjunction with GSM standards is expected to be used in developing and deploying Personal Communications Networks (PCN).

This diagram shows areas of interaction between a service application and its environment, computer and telecommunications industry standards are mapped into the diagram.

As the various standardization activities deliver implementable specifications Digital will integrate these into products.

The combination of the IN and GSM concepts would provide an advanced starting point for addressing the business requirements of mobile service providers.

SLIDE 8



SERVICE & REGISTER MASTER DATA BASES

HLR

AUC

EIR

NETWORK OPERATIONS MAN MACHIN INTERFACES

SERVICE PROVIDERS (AIR TIME RE-SELLERS) MAN MACHINE INTERFACES (remote access)

DATA BASE SVCS

HLR MNGT APPN

AUC MNGT APPN

EIR MNGT APPN

NEW SVCS MNGT

APPN STATUS REP'TS

DATA BASE UP-DATES

SMS MGMT APPNS SPECIFIC TO TSP

SYSTEM MGMT SVCS

APPLICATION RUN TIME ENVIRONMENT

OLTP ENVIRONMENT

PLATFORM O/S

SCP Interfaces

Switch database interfaces (VLR)

Switch database interfaces (VLR)

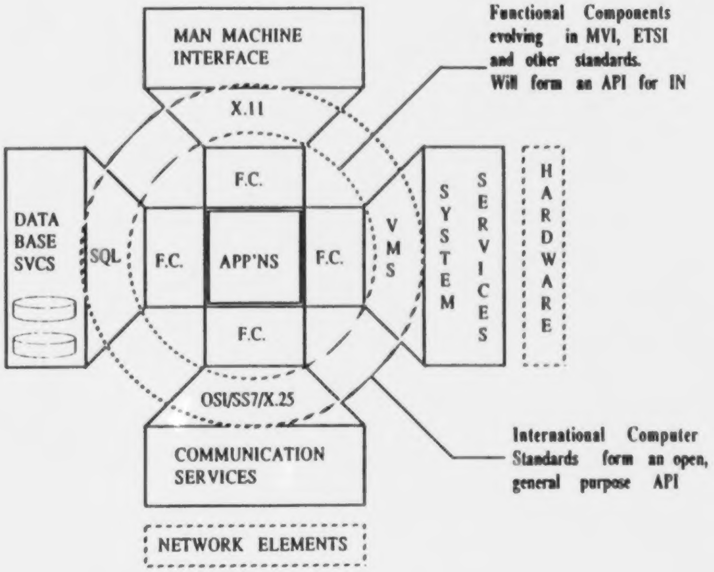
NETWORK MANAGEMENT COMMUNICATIONS (OSI, ETC)

Functional Elements of Mobile Services Management System,

SLIDE 9

APPLICATION INTERFACES

MOB_04



MAN MACHINE INTERFACE

X.11

DATA BASE SVCS

SQL

F.C.

F.C.

APP'NS

F.C.

F.C.

VMS

SYSTEM SERVICES

HARDWARE

OSI/SS7/X.25

COMMUNICATION SERVICES

NETWORK ELEMENTS

Functional Components evolving in MVI, ETSI and other standards. Will form an API for IN

International Computer Standards form an open, general purpose API

N Daighton TSG VALBONNE

SLIDE 10 - IN DOMAINS

The figure shown here gathers the relevant standards for ISDN, Intelligent Networks (as far as they go today) and the GSM mobile and network management into a single picture.

The European standards activities related to digital cellular (and recently ETSI acceptance to base PCN standards on GSM requirements) have not accepted to provide any migration paths from the existing analogue networks. The main thrust was on defining an architecture to support pan-European wandering and the anticipated sustained growth expected in the 1990's. The harmonization of the pan-European network is based upon standards covering all aspects of network infrastructure, common air interface and call hand-off between operators.

The goal of the Cellular Telecommunications Industry Association (CTIA) is mainly to increase bandwidth to alleviate the capacity problems in large population centers caused by current radio spectrum restriction. A further requirement is that of coexistence of the EIA and EIA digital systems.

Unlike the GSM specifications, the EIA system allows proprietary base stations, hand-off algorithms and control protocols. The IS-41 standard is an attempt by the EIA/TIA to define hand-off between different operators and inter-system call delivery mechanisms.

Transparent roaming and access to advanced mobile services across North America will be facilitated by using general purpose computing technologies which are exploited by today's Intelligent Network services.

SLIDE 11 - IMPACTS OF NEW SERVICES

This slide represents a simple view of the areas that are affected whenever a new service is introduced within the network. In order for a network operator to be responsive to customer demands and competitive pressures new service provisioning has to become effective and efficient.

Understanding the network and operational impacts of an accelerated service deployment mechanism is part of the integration exercise required when deploying Intelligent Networks.

During the next ten years, the number of users of mobile communications services will grow from 6 million world-wide to perhaps ten times that number. There are forecasts that the number of PCN users in Europe will ready 8 million by 1998. GSM will count 6 million users in the same timeframe while today there are only 2 million users in Europe.

While the number of users grows, the size of the cells must be reduced to optimize the use of the radio spectrum available. Some GSM operators are planning to adopt micro-cell techniques to allow them to emulate the PCN networks. As the cell diameters drop from kilometers to a hundred meters or so the problems of call hand-off to adjacent cells and tracking a mobile through cells (so incoming calls can be delivered) becomes more difficult. France Telecom is already examining the impacts of people using personal phones on the new high speed trains (TGV) which travel at speeds of more than 300 kph.

The need for integration of the mobile networks, Integrated Digital Services Network (ISDN) and future broad-band networks from a service perspective is becoming clear. Customers will find it increasingly difficult to keep track of the multiplicity of phone numbers (a home, work, car mobile, hand portable etc.etc.) It will become the network intelligence's task to find a particular user based upon his unique number, his habits, time of day and day of week, etc.

It is only by implementing an appropriate architecture today that the fixed and mobile network operators can prepare for and succeed in the 1990's. Such an architecture must allow cost effective introduction of services, detailed billing, facilitate new customer connection and service subscription, while supporting the resultant increase in network database access, signaling network traffic and corresponding management implications.

Services which span networks should present similar characteristics to users. As network diversification continues, service integration becomes more important. Users should not encounter confusing differences between similar types of service offered via different networks. Essentially network intelligence will ensure that 'user friendliness' is an integral part of public telecommunications. Intelligent Networks render services independent of the underlying switching and connectivity domain. IN will play a vital role in service provisioning and integration across differing networks in the future.

SLIDE 10

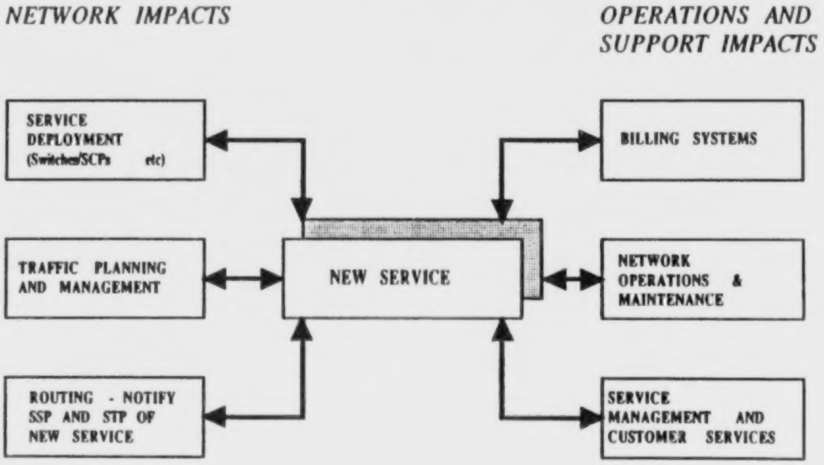
ISO LEVEL	ISDN	IN	MOBILE NETWORKS			NETWORK MANAGEMENT
	SWITCH	SCP/SSP	VLR, HLR MSC/MSC	MSC/MS	MSC/ BSC	ALL NETWORK ELEMENTS
7	ISUP TUP	TCAP	MAP TCAP	DTAP	BSSAP	FTAM, CMISE ETC
6						Presentation X.226
5						Session X.225
4		CONNECTIONLESS		CONNECTION		Transport X.224
3	CCITT Q.711 - 714 (SCCP)					X.25
2	CCITT Q.701 - Q.707 (MTP)					LAPB
1	SIGNALLING SYSTEM 7					X.25, X.21 X.21bis etc

STANDARDS IN ISDN, I.N. AND GSM MOBILE

SLIDE 11

IMPACTS OF NEW SERVICES

MCR_11



NETWORK IMPACTS

OPERATIONS AND SUPPORT IMPACTS

SERVICE DEPLOYMENT (Switches/SCPs etc)

TRAFFIC PLANNING AND MANAGEMENT

ROUTING - NOTIFY SSP AND STP OF NEW SERVICE

NEW SERVICE

BILLING SYSTEMS

NETWORK OPERATIONS & MAINTENANCE

SERVICE MANAGEMENT AND CUSTOMER SERVICES

[illegible] FEBRUARY [illegible]

N Deighton TSG VALBONNE

"Personal Communications Networks For Newly Emerging Countries"

Harold W. Clark
Strategic Marketing Director
Radio-Telephone Systems Group
Motorola, Inc.

PCN (Personal Communications Networks) is a concept that has already progressed to implementation and which promises to bring truly mobile, wireless communications to the mass market. With that promise nearly everyone, from individuals to governments, is asking: what is it, what will it cost, when will it be available?

In the United Kingdom, the Department of Trade and Industry sought competition to its duopoly cellular licence holders. Their observation was that without using the very latest in wireless technology the average consumer might not see mobile communications in her or his price range for a number of years, if at all. The capacity of existing analogue cellular, and the current plans for evolution to digital cellular (with resultant higher capacity) would not provide wireless communications to the mass market. The DTI paper, known as "Phones on the Move", envisioned a personal communications network that was ubiquitous in its coverage of the UK, with exceptional capacity, accessed by small, low cost handsets. In addition, it had to offer pan-European compatibility to meet the European Community objectives. Three consortia have been granted licences for this service in the UK.

The secret to PCN's high capacity is in its specification of a 1.8 GHz transmission standard, which allows small micro cells deployment. The micro cellular structure, combined with the decision to introduce quarter watt handsets and low powered infrastructure, will result in small handsets with superior battery life, as well as a compact site infrastructure.

Picture with me a service giving a seamless coverage using cells of, say, one kilometer in diameter to serve neighbourhoods, or several kilometers long to provide motorway coverage. Transmission equipment to serve these cells will be housed in a box the size of a suitcase, with antennae located on houses, office buildings and, occasionally, on a monopole.

Smaller cell coverage areas could provide a public network to a dozen buildings in an urban environment. In the home, the PCN phone can be used around the house, in the yard, around the neighbourhood, WITHOUT the usual cordless 100 foot limitation. In this mode of using the "local cell", the minutes of usage can be billed as a premium above PSTN rates in recognition of its added mobility.

Let's get in the car and head for work. Now the system recognises that the PCN phone is out of the "home cell" and is mobile. Handovers are transparent as the user travels through the grid of micro cells. PCN has handover capability up to approximately 85 mph using the pan-European GSM-based standard.

After completing the journey in a mobile mode, the user puts the handset in his pocket and heads for the office. While walking across the parking garage, or attempting to cross the street, the user handset is still on the PCN public network in a mobile mode.

Once inside the office, say, on the third floor, he can immediately come under the control of an in-building "business cell". All calls to his personal number now are directed to the "business cell" which provides indoor coverage through a Centrex-like service, or a PBX, possibly a wireless PBX.

The wireless solution is complete, from cordless in the home, to mobile in the car, train or bus, to an effective voice communicator in the office.

What about international service? PCN is pan-European in concept and, therefore, the phone will work in any subscribing country or city. Obviously, this concept can be extended to other areas of the world.

Clearly, the technology to provide the "wireless evolution" is visible and capable of meeting communications needs across the range of applications from cordless phones for the home, to mobiles, to local/urban calls through to national and global network coverage. For those who wish personal communications, no matter where in the world, it's coming!

Countries are currently evaluating their future communications strategies. Technology advances make it a timely imperative. The 1990s will see a political climate in which countries will create the framework for their communications infrastructure of the 21st century.

The wireless solution will be a key complement to existing quality land line infrastructures, or provide an economic alternative where they do not exist.

Communications have been described as "the engine of the economy". Wireless, mobile solutions are an excellent, innovative twenty first century type of "engine". But to reach their full potential, wireless communications must overcome the traditional bias of many telecommunications decision makers, as well as the limits of spectrum availability, and the conservatism surrounding large infrastructure investment decisions.

How do the costs of wireless communications compare to the fixed land line network? The problem is to determine what it costs per subscriber to install a land line. After 105 years of telecommunications history, 105 years of building central offices, stringing, burying wire and fiber optic cable, it is very hard to say. It ranges from a minimal cost central office software command to connect a house already wired with modular jacks, to the expensive solution of stringing cable across rivers and mountains in a newly developing area.

Do we calculate incremental cost or fully allocated cost? Do we take the whole infrastructure cost of Des Moines, Iowa and divide it by the number of subscribers using a 20 year life for central office and a 30 year life for buried cable? The variables of accounting, cost of labour and materials and the service life make any estimates subject to a chorus of differing viewpoints.

My own estimate ranges from $1,400 to $2,500 per land line for establishing local networks.

PCN -- digital, low power, higher frequency, with even greater capacity than a traditional cellular infrastructure -- should be able to deliver an installed infrastructure average cost of below $500 per subscriber, BEFORE seeing a capacity limit. Let me emphasize AVERAGE here, as radio environment, terrain and other obstacles will impact the installation costs.

The investment payback depends, as always, on the number of subscribers and their payments.

We can estimate the average US land line subscriber bill to be $20 per month. Then, let's set our estimated PCN average subscriber bill at $30 per month, somewhere between land line and cellular.

Assuming economic capacity in both instances, the average capital cost per land line subscriber is $1,700, which, based on average monthly revenues of $20, would require 85 months to recover. On the other hand, the average capital cost per PCN subscriber of $500 would require 16 months to recover at $30 a month.

Additionally, a land line type of investment needs regulatory guarantees to cover a long term capital investment.

Therefore, PCN can be an economic complement to existing high quality land line infrastructures by bringing mobility to an otherwise tethered subscriber. PCN can also be an economic alternative to new land lines, with a better rate of deployment.

A telephone company viewing itself as a communications company, not as a wire and cable company, should see PCN as value added communications WITH THE CAPACITY FOR SUCCESS.

Whether PCN is a telephone company offering or a competitive service, or both, depends on the regulatory and political environment. The spectrum availability issue for such wireless solutions requires national, continental and, indeed, worldwide agreements. However, provided that solutions give the expected added value, substantial implementation will occur in the next 10-15 years, not in 100 years.

FUTURE WIRELESS COMMUNICATIONS FOR THE UNITED STATES

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Abstract

Advances in radio technology and micro-electronics will provide the ability to offer increased voice and data capacity over each channel using smaller, lighter sets, and providing improved transmission quality, at an affordable price. These advances will necessitate the development of an appropriate regulatory structure to facilitate the introduction of new services. This paper provides an overview of competing wireless technologies and the related regulatory issues that are important as new applications and services are proposed.

Introduction

As regulators and service providers prepare for the next millennium by developing services meeting expanding telecommunications needs, they can count on continued rapid development of computer hardware, transport capacity, software capability, database technologies, machine and artificial intelligence and wireless technologies to facilitate their efforts. One of the needs they will be required to address is a peripatetic public's expectation of a mobile communications infrastructure, at least national in nature and probably international in application, that offers expanding intelligent services with universal two-way access capability through light-weight, fully featured and reasonably priced telephone handsets. Such services will satisfy public demand, address the need of each society's changing demographics and dynamics, and increase productivity.

Advances in, and applications of, digital radio technology and micro-electronics will result in the ability to offer increased voice and data capacity over each channel using smaller, lighter sets, and providing improved transmission quality and sufficient battery life - all at an affordable price for the mass market. This will permit increasingly complex and more fully featured mobile services, including the expansion of cellular capacities, and the introduction of wireless loop applications. It will also increase the number of competitors offering wireless services, as various forms Personal Communications Services (PCS) evolve to meet the needs of this expanding market. Indeed, as early as 1995, some industry leaders expect that 25% of all United States' public network traffic with either originate or terminate on a wireless link.

This paper provides an overview of competing wireless technologies and the regulatory issues that are important as applications and services emerge. It will explore the evolution of the cellular network, describe the impact of wireless technology on public and private networks and evaluate the efforts underway for the introduction of PCS, including both technical and regulatory issues.

Wireless Services-Background

The prodigious efforts to improve the technologies forming the backbone of wireless communications, and the unremitting endeavors to shape the regulatory structure governing it, has been fueled by the unexpectedly high, and continually increasing, public acceptance of wireless services. In particular, the short, yet extremely successful, history of cellular and cordless telephones is strong evidence of the public's interest in mobile communications.

Cellular Communications

From its inception, cellular services have been geared to the business executive or professional requiring quality, reliable, custom-featured service in a high speed (vehicular) mobile environment. Cellular technology was designed to increase the numbers of customers that could utilize the nation's airwaves by providing coverage areas shaped as hexagonal cells, permitting the significant reuse of existing frequencies.

Once considered suitable only for voice communications from a vehicle, cellular services now include portable voice, data and facsimile capabilities. Its rapidly developing customer base and the unavailability of new radio spectrum has prompted manufacturers to develop smaller, portable, battery-operated handsets increasing the customer's comfort and access zone. As of 1987, 72% of cellular customers came from small business, 20% from large business and 8% from individual consumers. Today, the highest usage pattern still comes from the early adopters of the service, such as those in the real estate, construction and sales industries.

Cellular providers now offer coverage to 88% of the United States population, a number that is expected to increase to 97% by 1995. Yet, despite the rapidly accelerating growth of analog cellular systems, some of which are at or near system capacity, cellular service has penetrated only 3% of the US telecommunications service market. The huge consumer/household market remains virtually untapped, awaiting for the deployment of digital systems that promise to dramatically increase capacity and drive down the air time and access charges.

Cordless Telephones

Another wireless option for customers is the cordless telephone. Cordless telephones were introduced in the late 1970's. By 1982, annual sales were two million per year. Since then, annual sales of these $100-$200 devices have been between 4 and 6 million a year, with cumulative sales exceeding 25 million in 1987 and 30 million today. Thirty percent (30%) of U.S. households use cordless telephones. Operated in the 46/49 Mhz bands under Part 15 of the FCC's Rules, cordless phones may be used only within a limited range of the base station and are susceptible to interference from other devices, including baby monitoring devices and garage door openers. Cordless telephones are designed for voice only service and though they provide all network features, including two way calling capability, transmission quality has only recently begun to improve with the introduction of higher quality products. The introduction of the second generation cordless telephones, using digital technology, and offering better transmission quality, privacy, and greater usable range, should further improve the utility of these devices. Cordless phones have also progressed towards small, lightweight and pocket sized handsets, offering full range performance for indoor and outdoor use (up to 500-1000 feet away from the base station).

Other Public and Private Uses

Other narrower uses of radio technology for service provisioning include Basic Exchange Telecommunications Radio Service (BETRS) and Specialized Mobile Radio Services (SMRs). Local Exchange Carrier (LECs), and other state authorized entities, can provide radio access for plain old telephone service (POTS) in rural areas of the U.S. BETRS provides consumers access to the PSTN network via radio links from an outdoor antenna to the central office. These links are transparent to the consumer who plugs the telephone into a standard RJ-11 jack. A primary motivation for using this technology is the projected economic savings over conventional wireline distribution technologies in rural areas.

BETRS radios operate on ninety four (94) 25 Khz channels in the 150, 450 and 800 Mhz bands. Operation of BETRS in the 800 Mhz band is prohibited within 100 miles of the top 54 MSAs, though no such restriction applies in the other two bands where they enjoy co-primary status with the Public Land Mobile Service.

Specialized Mobile Radio Services, authorized as private operators, offer voice dispatch services to its approximately 1,000,000 subscribers. Businesses are the primary users of these services.

Radio Regulation-Background

To better understand how the decisions affecting these, and proposed future, wireless services will be made, let us briefly examine the international/domestic regulatory environment and the several processes and agencies involved in the setting of radio telecommunications policy.

International Regulation

International radio spectrum regulation is under the auspices of the International Telecommunications Union (ITU). The ITU, an agency of the United Nations, has overall responsibilities in determining international frequency allocations. Allocations, operation and qualifications are determined for each of three world regions. (Region #1 being Europe, Africa and most of Asia, Region #2 covering North and South America, and Region #3 is southeast Asia, Australia and New Zealand.) The ITU:

- effects allocation of the radio frequency spectrum, the allotment of radio frequencies and registration of radio frequencies and associated orbital positions in the geostationary satellite orbit in order to 1avoid harmful interference between radio stations of different countries; and
- coordinates efforts to eliminate harmful interference between radio stations of different countries and to improve the use of the radio frequency spectrum and of the geostationary satellite orbits assigned for radio communication services.

The ITU has under its auspices Plenipotentiary Conferences, Administrative Conferences, e.g., the World Administrative Radio Conferences (WARCs), Administrative Council, General Secretariat, International Radio Consultative Committee (CCIR), International Frequency Registration Board and International Telegraph and Telephone Consultative Committee (CCITT).

Under the Treaty agreement, the Member nations normally regulate and license operation within particular jurisdictions. Problems arising during operation of a particular service in different jurisdictions should be resolved by the parties involved. Sometimes a bilateral agreement may result. Other times the issue may be brought to an appropriate Administrative Conference for discussion. In 1992, a WARC will convene to discuss personal communications service and the potential worldwide allocation of frequencies in the 1-3 GHz range.

The ITU at its 1992 WARC will be examining the need for, and possible worldwide allocation of, spectrum in the microwave bands for PCS. The appropriate agencies in member countries, such as the FCC in the US, have started inquiries to develop the PCS issues as they may relate to the international allocation. The US position will be represented at WARC '92 by the US Department of State.

Domestic Regulation

Domestic radio spectrum is regulated by the Federal Communications Commission (FCC) and National Telecommunications and Information Administration (NTIA). The FCC is an independent government agency, responsible directly to Congress. The FCC, by virtue of the 1934 Communications Act, has jurisdiction over the utilization of the public portion of the radio spectrum.[1] NTIA, part of the Department of Commerce, regulates the radio spectrum set aside for use by Federal Government agencies.

In the United States, radio spectrum is completely allocated at the lower frequencies (below 1 GHz) except for a meager non-contiguous 3 MHz. A new or existing public radio service that requires an allocation of radio spectrum to operate, must file with the FCC a "Petition for Rulemaking" which seeks to re-allocate an existing allocation to replace or include that service application. Upon such a request, the FCC has two courses of action available. It may decide that, based on the petitioner's offered justification, the intended use of the spectrum is meritorious and, therefore, place the petition on public notice. If, however, the request appears unreasonable or inappropriate at the time, the Commission may dismiss the petition with a "Memorandum Opinion and Order." If assigned a rulemaking number and placed on public notice, the public is given up to 30 days from the date of the public notice to file comments either supporting or opposing the new allocation. Once comments have been filed, an additional 15 day period is allowed for reply comments. After comments and reply comments have been received, the Commission has two choices. It may continue the proceeding by adopting a "Notice of Inquiry" or "Notice of Proposed Rulemaking," or it may terminate the proceeding with a "Memorandum Opinion and Order" or a "Report and Order". Continuance of the proceeding could last for an extended period of time, possibly several years.

Reallocation of Radio Spectrum

For the past 40 years, when allocating spectrum for new radio services, the FCC has made its determination based upon six principles or considerations. Known as the "traditional" approach" to spectrum allocation, these six considerations include:

- whether radio is necessary or whether non-radio alternatives provide a practical alternative;
- whether the proposed radio service has social and economic benefit and, in part, whether the proposed service will be used for public safety purposes;
- whether many people will benefit from such a service;
- whether the proposed service is viable from a social, technical and economic standpoint;
- whether the requested frequencies are the most appropriate for the proposed service; and
- whether existing users or the public, or both, would incur unacceptable costs in accommodating the new service.

This structure and the attendant processes of radio regulation has served the United States well in the past. Today, however that success has forced the throttling of many new and innovative proposals for radio service and use because of the dearth of any sizeable amount of spectrum below 1 GHz; indeed even below 3 GHz, the prospects of finding fallow spectrum are very slim.

In response to this situation, the FCC and NTIA have conducted studies and inquiries, and proposed potential solutions. The NTIA recently completed an NOI on Spectrum Management in the United States. The FCC recently issued an NOI on Personal Communications Services in the US, after having received several requests for rulemakings, rule waivers, and experimental licenses. The FCC also recently proposed a Pioneer's Preference, which would grant a preference for licensing to those who introduce a service. The Congress has also proposed legislation to attempt to alleviate the situation.

United States Legislative Activities

United States Congressman John Dingell, Chairman of The Energy and Commerce Committee, has introduced legislation to transfer 200 MHz of radio spectrum, below 5 GHz, from the Federal Government sector to the public sector. This bill is aimed at providing spectrum to facilitate the development and implementation of emerging technologies, though it does not specify particular technologies.

Known as the "Emerging Telecommunications Technologies Act of 1989," HR 2965 specifies that within 24 months of the date of enactment, the Secretary of Commerce must recommend a total of 200 MHz of spectrum in the government's reserve that can be made available for commercial assignment. Further, it requires the Secretary of Commerce to convene an advisory group from affected industries and the FCC to provide him or her with an independent data base to evaluate recommendations. This group will also be required to make recommendations to the Congress on how the current system of allocating frequencies should be reformed.

Such legislative efforts, as well as other efforts in the regulatory area, some of which will be described later in this paper, highlight the enormous impact of wireless services on an enthusiastic public whose appetite for such nities being predicted as a result of the new technical and regulatory developments. Future efforts will have to be aimed at ensuring the public's need for wireless access is facilitated through a regulatory environment encouraging the responsible introduction of the new technologies and services made possible by the following emerging technology trends.

Emerging Technology Trends and Wireless Service Expectations

Advances in Digital Modulation and Voice Coding Schemes

Improved digital modulation and speech compression technologies, the evolution towards smaller coverage areas (microcells) and possible, though less certain, increased spectrum allocation, will provide both extant and proposed services, such as cellular, wireless loop access and other forms of Personal Communications Services, with new alternatives for growth potential. Modulation technology will offer improved quality of service with enhanced channel capacity as developments in Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) techniques progress.[2,3] Both of these methods compress more than one voice channel on a particular frequency channel with TDMA transceivers differentiating messages by sending them in carefully timed packets to receivers prepared to detect the proper message by choosing the correct time to listen to the message, while CDMA messages are spread over a wide bandwidth by distinguishable orthogonal codes which permit the extraction of the desired message at the receiver. At present, Frequency Division Multiple Access (FDMA), permitting 57 voice channels (one per radio channel) per cell is used in cellular systems. Messages transmitted in FDMA mode are separated only by frequency.

The imminent introduction of digital technology, (30% of the operational cellular sets are expected to be digital by 1996), will soon increase cellular capacity. The expected introduction, by the end of 1991, of TDMA technology based on the recently released digital cellular standard, IS-54, will initially allow three voice channels on every radio channel, a number anticipated to increase to six (6) in the 1992 time frame. CDMA, which uses codes to spread the message over a wider bandwidth, with the appropriate message distinguished by a distinct code, is less susceptible to multipath and interference effects and, due to the exceedingly high number of available orthogonal codes, will be able to offer even further voice channel compression, especially as microprocessor technology improves.

Improvements in speech compression technology will result in higher quality speech at lower bit rates. The 1972 CCITT standard (G.711) set the network standard at 64 kbps using Pulse Code Modulation (PCM), a type of waveform coding because it involves the operating on, and reproducing of, a facsimile of the actual speech waveform. Standards activities for lower bit rate voice coding have tended to concentrate on redundancy-removing operations to reduce signal energy at the input to the amplitude quantizer such as in the 1984 CCITT 32 kbps standard (G.721), which uses Adaptive Differential Pulse Code Modulation, also a form of waveform coding. Though low bit rate coders have been developed, future standard voice coding techniques are expected to continue to rely on redundancy reducing techniques. In contrast, vocoders, which distill speech into a compact description based on a model of speech generation in the voice tract, thus reducing the number of parameters that must be digitized, yield more artificially sounding speech. They are expected to continue to be used for 2 kbps speech. Hybrid coders, which combine the performance of the algorithms of waveform coding with the compression efficiency of the model-based vocoders are expected to be used to digitize speech at 16, 8 (the IS-54 standard) and 4.8 kbps.

Introduction of Microcells

The evolution towards microcellular technology using small cell coverage areas will result in greater frequency reuse. This trend will permit the introduction of lower power transmission which, when combined with the application of micro-electronics to portable handsets, will hasten the introduction of smaller, lighter, more reasonably priced sets, offering acceptable talk time between battery charging, and improved transmission quality. Indeed, this trend is already noticeable in cellular phones which have progressed from the mobile (suitable for cars) to the transportable (suitable for suitcases) to the presently available handheld portables. As handheld portables get lighter and smaller, the increased convenience and opportunity for impulse calling will increase cellular usage, a circumstance which will be augmented by the continuing decline in the costs of analog cellular telephones.

The combined deployment of microcells with CDMA technology will greatly expand system capacity,providing a capability for a multitude of wireless services, including wireless loop applications. For example, assume the average demand on the telephone network of 4089 ccs/square km., 104 ccs/square km. and 4.4 ccs/square km. in urban, suburban and rural settings, respectively.[4] Anticipating microcellular configurations to decrease the cell radius to 1300 feet or 0.25 miles in the near future, and using the amount of frequency corresponding to 6 of today's cellular channels, one can show that radio capacity will increase from the 1985 cellular capability of 0.94 ccs/sq. km to 3422 ccs/sq. km. and 7518 ccs/sq. km. with the introduction of 10 voice channel and 20 voice channel (per RF channel) CDMA, respectively.[5] These latter two numbers are very close to the average urban demands on the public network and suggest that CDMA will be able to handle more than one to two-thirds of the seven million subscribers to the PSTN in the New York Metro Region for wireless loop applications.

Such astounding advances in technology - which will permit providers to "connect" even a congested urban area using a fraction of a frequency band which today, though near capacity in several areas, can only serve about 3% of the population - will open the door to a panoply of wireless services limited only by the human imagination. A sampling of these potential services are described below.

Wireless PBX and Wireless Centrex

Wireless PBX/CENTREX services are ideal for large companies with high churn rates. Reducing the need for inside wiring, it eliminates many of the administrative tasks of inside moves and rearrangements, while improving office aesthetics and enhancing employee mobility. Akin to an indoor cellular system, wireless PBX offers multiple exchange lines for PSTN or PBX connections. Systems permit multiple handset registrations permitting the full gamut of inter-office communication capabilities now associated with conventional PBX or key systems of similar size. Connection to the PSTN or PBX is achieved through small, portable low power handsets. Using a frequency reuse pattern in the three dimensional office building configuration, coverage area and grade of service is improved as necessary by the placement of additional base units. Several companies, including GPT, Ericsson, AT&T, NEC, NTT are working on these systems. Their proposed equipment is based on the several standards which have developed with distinct philosophies about the integration of indoor wireless services with outdoor Telepoint systems. These standards include the UK CT-2 standard, which envisions Telepoint services migrating to indoor wireless services, the Swedish originated Digital European Cordless Telephone Standard (DECT/CT-3) which proposes the evolution of indoor business service to residential and outdoor service, and the Japanese Enhanced Service for Cordless Telephones (ESCORT).

Wireless and Private Networks

Mobile Data Services - Wireless Local Area Networks (LANs), consisting of a base station computer and network transceiver units, eliminate the costs and restrictions of traditional hard-wired networks while offering users complete mobility. Connected computers, which may be part of a full peer to peer wireless LAN or wireless extensions to wired networks or even wireless connections of laptops, belong to the user and not the wall. These networks, which provide two-way data transport, are ideally suited for environments - such as manufacturing, warehousing or stock exchange environments - where physical wiring is not practical yet on-line information is essential. For example, wireless LANs offer the opportunity for care givers to instantly and remotely access and update a patient's record at the point of care. They can eliminate the need for the paper driven systems of the financial trading floors, while simultaneously enhancing the integrity of the market. They permit terminals to be scattered within a building or within several proximate buildings, eliminating the high cost of running cable to each terminal and providing mobility and portability.

The market for such data communications equipment and services is growing at an accelerated rate, driven by a highly mobile work force increasingly dependent on computer-based technology. A number of large corporations, including IBM, Federal Express and United Parcel Service have built their own nationwide mobile radio data systems permitting field personnel to communicate with the corporate data processing center. Recently, IBM and Motorola announced a joint venture, called Advanced Radio Data Information Service (ARDIS), which will provide two-way nationwide advanced radio data service. Operating in the 800 MHz band, this service proposes to give customers access to various databases and information systems. This integration of IBM's nationwide private radio data system and Motorola's radio data network promises to accommodate 24-hour service in more than 8000 municipalities.

This past February, Ardis and the Data Group corporation, a NYNEX company, announced an alliance to develop an interface that will enable service organizations access to the Data Group's FIELDWATCH service management system through the ARDIS radio network. Various devices, including personal computers and other handheld terminals, will interface with REMOTE-PLUS, a module in the FIELDWATCH system, permitting direct communications between remote field engineers and the host system central database.

Perhaps the most exciting idea is PCS.

The Case for Personal Communications Services (PCS)

Currently, PCS is a conceptual approach to meeting the communications needs of people with different lifestyles, patterns of mobility and work functions. It has been the icon of the trend towards meeting all communications needs - without wires. Champions of the evolution of telecommunications capabilities toward PCS envision the eventual ability to conveniently and inexpensively achieve ubiquitous two way communications using small, low powered handsets connected to the PSTN through radio links to low power transmitters, each the size of a small file cabinet, strategically and unobtrusively placed throughout residential communities, business complexes, public places, shopping malls, etc. These proposed systems will use advanced network intelligence to provide multi-network roaming and permit the "service profile" to follow the mobile user - thus facilitating consistent feature delivery and accessibility - allow automatic or selective registration, and spur the use of consistent user management systems for user ID, billing and authentication.

Proponents argue that PCS will address the still untapped mass market demand for inexpensive mobile telephone service that permits one to "stay in touch" whether at work or play. The PCS concept extends into the business environment where employers will benefit by the removal of the need for employees to be strapped to their desks while awaiting a phone call, and perhaps, more importantly, eliminate the frequent, disruptive and costly telephone moves and additions.

In the United States, any number of proposals have been made to better define and promote the technology suitable for PCS and its applications. For example, Bellcore has proposed a Universal Digital Portable (Radio) Communications (UDPC) service. In Bellcore's view, UDPC would enable consumers to use small handsets to connect to the PSTN through strategically located radio ports. Bellcore proposes that the antennae for the radio ports providing coverage in residential areas be located unobtrusively every two thousand feet at about 25-30 feet above the ground. In buildings, port separations would be up to 60 meters with frequency reuse schemes maximizing efficiency. Channel spacing in the proposed system might be between 150 and 300 kHz; the speech coding rate would be 16 kb/s with the demand assigned channels scheme permitting the system bit rates to increase in 8 kb/s increments, up to ISDN rates. The low power portables would transmit an average of 5 mW, and the access mode would be TDM/TDMA.

Others have different views of the immediate evolution of wireless services - and whether, and how, they lead to PCS or not. Federal Digital Cellular has petitioned the FCC to permit a third cellular licensee in each city. Fleet Call has requested that the FCC grant it the flexibility to create an enhanced SMR microcellular based network using advanced digital radio technology to offer expanded voice and data communications. Cellular 21 has requested and received experimental licenses for CT-2 operation. In addition, Cellular 21 requested that the FCC reallocate a portion of the spectrum for services based on that technology. PCN America/Millicom, has received experimental licenses to test a microcellular based, low-power CDMA Personal Communications Network (PCN) that envisions integrated network intelligence (e.g., Signaling System #7) so that alternative end-to-end ubiquitous two way communications capabilities may be implemented. It petitioned the FCC for an allocation for PCS services in the 1.7-2.3 GHz band. Over thirty other organizations have also requested or received experimental licenses for various versions leading to PCS.

The Telecommunication Industry Association (TIA), filed a Petition for rulemaking on April 30, 1990, requesting that a new Part 16 of the Commission's Rules be promulgated. Arguing that cordless telephones have outgrown the parameters of Part 15 rules on a secondary status and, instead, warrant a primary allocation of 25 duplex channels pairs (they now have 10) in the 46/49 MHz bands, the TIA requested that the FCC coordinate with government users of the proposed new band through the Interdependent Radio Advisory Committee and the National Telecommunications and Information Administration.[6]

Regulation is Adapting

FCC Examines the Capability and Need for PCS

The many requests for experimental licenses and rulemakings and rule waivers to authorize various PCS investigations and applications has prompted the FCC to issue a Notice of Inquiry (CC Docket No. 90-314, Amendment of the Commission's Rules to Establish New PCS) concerning the future of microcellular based technology and its application, broadly described as PCS, in the United States. The inquiry resulted in 106 sets of Comments, most of which supported the concept of PCS in principle, though no clear path for achieving it emerged in the first round. Commenters did not agree on the market structure of the proposed services, who should offer them, which technology should be used, and in which portion of the spectrum the services should be provided. The authors believe that the FCC should continue to encourage the provision of PCS by the cellular providers (discussed later) in the 800-900 MHz. In addition, the FCC should begin another proceeding to examine the need for wireless technology in the provision of local exchange services separate and apart from its consideration of PCS deployment in the microwave bands.

Wireless and Basic Telephony: The Public Weal

An exciting application of radio technology that emerged in the FCC's NOI is the use of radio in the loop system. Proposed by NYNEX, it meets all the traditional criteria for allocating spectrum including the crucial public interest requirement. Indeed, the public weal is well served in cases where cable cannot be placed due to terrain, cost, or other factors and yet wireless technology ensures state-of-the-art telephone service is available. Wireless local exchange service permits rapid service restoration and the essential coordination of emergency forces during natural disasters or other life threatening events. The technology permits the introduction of virtual circuits and the possibility of adding second and third lines quickly in locations where this is not now possible. Radio systems in the loop, particularly when integrated with intelligent network capabilities, will facilitate the provisioning of service in a nearly instantaneous fashion, allowing LECS to move customers temporarily to wireless while other facilities are being repaired. Services and capabilities that provide for survivability where no service downtime is acceptable will be greatly enhanced using wireless in the local distribution system.

On August 1, 1990, NYNEX Science and Technology, the research arm of the NYNEX Companies, applied to the

FCC for an experimental license to investigate the feasibility of using digital radio technologies as an alternative to existing wire methods in the local loop. NYNEX will test spectrum efficient Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) radio links at 1850-1990 MHz between selected phone company locations and customers in New York City, Boston and White Plains. The tests, which are scheduled to begin in 1991, will help establish possible coverage areas, calling capability and other engineering requirements necessary for understanding and evaluating the benefits of using radio technology as part of local access. These tests will generate data useful in a rulemaking proceeding for wireless in the local exchange.

FCC Authorizes Increased Flexibility for Cellular Operations

Recent FCC decisions have displayed the Commission's desire for ensuring that the public receive the best possible mobile services potentially available as a result of these technological advances. On December 12, 1988, the FCC released a Report and Order in Docket 87-390, mandating the Liberalization of Technology and Auxiliary Service Offerings in the Domestic public Cellular Radio Telecommunications Service. To meet its intended goal of providing "a regulatory structure that will facilitate the implementation of a new generation of cellular technology and services while preserving conventional cellular service through existing equipment and technology", the FCC granted cellular operators the option of implementing advanced cellular technologies or auxiliary common carrier services provided they continue to satisfy the demand for conventional cellular service and that these new technologies and services are secondary to conventional cellular service. This ruling has encouraged cellular operators to upgrade their capabilities by planning the introduction of digital technologies, such as TDMA and CDMA, and new services, such as PTS.

Cellular Industry Responds to FCC Initiative

Low Power - Personal Telephone Service (PTS)

On August 2, 1990, NYNEX Mobile Communications Company (NMCC) announced that it will introduce the nation's first wireless Personal Telephone Service (PTS). PTS will use small, light weight, portable telephones that will provide the user with "walk around" communications capabilities in specific geographic areas. It will use spectrally efficient digital CDMA technology and operate in its currently licensed cellular bands, as permitted by the FCC Docket 87-390 permitting flexible use of cellular frequencies. PTS will offer options for outgoing service only, with optional integrated pager and voice mail providing pseudo-two way calling capability, or full two way service. Introduction of this service is scheduled for late 1991 or early 1992.

Conclusions

Dramatic advances in radio and microelectronics technologies are making it possible for cellular providers to offer innovative services to their customers that extend well beyond the traditional car phone. The implementation of the technological advances for offering new and improved services has been spurred by the flexibility offered, by an FCC responsive to technological change. These developments have made the cellular industry a way to effectively and efficiently offer PCS. As this evolution will only accelerate over the coming years, cellular operators should not be sidetracked from developing the technologies associated with PCS. The continued development of new technologies and the chronic congestion within certain frequency bands (mostly below 3 GHz) will continue to necessitate case by case studies of the feasibility and/or offering other flexible use options for improved spectrum utilization.

These new advances in technology also open the way for the introduction of wireless technology in the local exchange network which offer unique advantages, distinct from those of PCS, and which meet the Commission's requirements for frequency allocation. The public weal is especially well served in cases where traditional cable approaches cannot be used because of terrain or other environmental factors. The public will also be well served by a technology that permits rapid service restoration and the introduction of second and third lines quickly in locations where this is now not possible. When integrated with intelligent network capabilities, radio systems in the loop will facilitate the provisioning of service in a nearly instantaneous fashion. Because of the dearth of spectrum allocated for wireless local loop applications, particularly in urban regions, careful attention should be paid to the need for spectrum for use by local exchange carriers in the LEC access applications.

A popular wireless option for consumers is the cordless telephone, with cumulative sales exceeding 30 million sets. Noting that cordless telephones have become a necessity, particularly for the elderly and physically challenged, that it has a projected annual growth of sales of 18%, and that it represents one of the most efficient forms of frequency reuse, the TIA has filed a Petition for Rulemaking, requesting a new Part 16 of the Commission's Rules. The TIA has requested that cordless telephones be given a primary allocation of 25 duplex channel pairs, instead of the 10 presently allocated to them on a secondary basis only. This request should be expeditiously granted to prevent unnecessary delay in service improvements to residential customers, the elderly and the disabled.

Investigations into other forms, or routes to PCS, should remain in the experimental stage until such time as sufficient operational results, which will be forthcoming under the various experimental licenses, are able to determine to what extent PCS services in the microwave region are viable. Thus the investigation begun by recent NOI on PCS should continue until such questions as to whether the developing technology, particularly in cellular, will permit the offering of PCS within the existing table of allocations are answered. Other issues that need to be resolved include the technical feasibility and relative merits of TDMA and CDMA, and whether technologies such as CDMA facilitate the possibility of disparate services sharing the same frequency band. Further, if and when new allocations are made, no company or industry one should be excluded from participating in the license process.

Footnotes:

(1) Radio operation within the United States is set forth in the Code of Federal Regulations, Title 47. Generally, the rules contained within the regulations specify the nature and type of wireless communications that are allowed, i.e., the service, the licensing, and the portion of the radio spectrum that is to be used. Other considerations include safety, interference, antenna size and spacing.

(2) Taub, H. and D. Schilling, "Principles of Communications Systems," McGraw Hill, New York, 1986

(3) Dixon, Robert C., "Spread Spectrum Systems", Second Edition, John Wiley and Sons, New York, 1984

(4) Rey, R. F., Technical Editor, "Engineering and Operations in the Bell System, Second Edition, AT&T Bell Laboratories, Murray Hill, N. J., 1984

(5) CCS refers to hundred call seconds per hour. It is a unit in the measure of traffic loads. Since there are 3600 seconds in an hour, a continuous traffic load in a 1-hour period represents 36 CCS or one erlang.

(6) TIA notes that: (1) cordless telephones have evolved from a convenience to a necessity especially for the elderly and the disabled; (2) cordless telephones have suffered a loss in spectrum, an increase in interference and a decrease in quality of service with baby monitors having the most damaging effect; (3) cordless telephones have a projected annual growth of sales of 18% through 1992; (4) the requested frequency are in the public interest and the technology provides one of the most efficient forms of frequency reuse (twenty five million cordless telephone users are covered by the essentially five frequency pairs allowed to cordless telephones after subtracting those frequencies used by baby monitors.

Tuesday, January 15, 1991

Working Groups Background Papers

Special Session Papers

NOTES

DISCUSSION PAPER:
BROADCASTING IN THE PACIFIC:
LIBERALIZATION, PRIVATIZATION AND NEW TECHNOLOGY

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This paper presents highlights of developments producing new opportunities in countries in the Pacific Rim for broadcasters and producers of programming. Largely responsible for these new opportunities are broadcast sector liberalization and privatization, and the emergence of new technologies. This discussion will be amplified at the Working Group entitled "Broadcasting in the Pacific," to be chaired by Michael Berg at the PTC '91 Conference in January, 1991.

Trends in the Region

Worldwide, the interest and activity in the liberalization of telecommunications regulation and in the privatization of telephone systems have been accompanied by parallel developments in radio, television and related forms of program distribution. These developments have included the opening of new opportunities for the ownership and licensing of existing and new broadcast stations and other types of facilities and a corresponding increase in the number of program channels among which listeners and viewers may choose. At times, this diversification has been accomplished through the use of newer technology concepts, such as low power television and satellite delivery of programming.

The changes on the "hardware" side of broadcast regulation -- producing increased facilities and opportunities for ownership -- have spurred companion opportunities for the development and distribution of programming, the "software" of broadcasting. Many have looked to Europe for such opportunities. They are also emerging in the Pacific Region.

Technological advancements in Japan, for example, have spawned an increasing appetite for entertainment programming. Across the Pacific, newly elected democratic governments in countries such as Chile may bring a further liberalization of, and reduction of the governmental role in, the broadcast industry. In turn, this will create new programming markets in Latin America as the addition of new, privately owned broadcast stations brings increased channel choices to Latin American consumers.

In this respect, as might be expected in a region as large and diverse as the Pacific Rim, the region is not homogeneous. Various countries are at differing stages of regulatory and technological development. The result is that different countries are at varying stages in the opening and expansion of their broadcast sectors, and present differing opportunities in programming.

In addition, regulatory liberalization and the spread of technology are tied to local recognition of traditional concepts of copyright. Several clashes over copyright have already been played out in the Pacific Basin, and new agreements to facilitate the spread and "interweaving" of technology and services have been forged. Long-standing deterrents to trade, such as piracy, are falling, particularly now with the United States' ratification of the Berne Convention on copyrights. The strengthening of copyright should foster increased production of programming in Pacific Rim countries that heretofore have not been major producers, and will facilitate trade in program product across the region.

Four Case Study Highlights

Developments in four countries -- Japan, New Zealand, Australia and Chile -- illustrate the diversity of change and ferment in the broadcast arena in the Pacific Region. These developments are highlighted below. Developments in this area are ongoing, and, of course, subject to change. The summaries below are brief sketches, intended to stimulate further discussion and exchange of information.

Japan

Perhaps the most dynamic market for exporters of programming is Japan. Direct Broadcast Satellite (DBS) and cable technology have expanded the television landscape in Japan considerably. DBS is more readily available than cable, currently reaching two million homes nationwide via Japan's public broadcast system, NHK. Cable, on the other hand, is available primarily in limited geographical areas.

Cable may yet reach its potential in Japan, however, as satellite cable services have recently been introduced via two new communications satellites, the JC Sat and the SCC Super Bird A. These services are expected to bring 14 new cable channels to Japanese consumers. In addition to DBS and cable, more than 30 regular broadcast networks are scheduled to begin operating soon.

Japan also has a very high VCR penetration, with 79 percent of households owning the machines. NHK, moreover, has been providing one hour of high definition television (HDTV) broadcasts per day, and may increase HDTV transmissions to eight to ten hours a day by the end of next summer. The HDTV sets currently being sold, however, are expensive, costing upwards of $30,000 (U.S. equivalent) apiece. Prices are expected to fall in the next few years, however, as more sets become available to consumers.

These new technologies expand demand in Japan for programming. This demand presents an opportunity for foreign business to the extent that domestic production is not economically feasible because of rising domestic labor and production costs.

A new agreement between the U.S.A.'s CBS and the Tokyo Broadcasting System (TBS), may be emblematic of an unexpanding broadcast-related sector in Japan. The new agreement will enable the two companies to share an international newsgathering system. CBS and TBS are also exploring opportunities to co-produce movies, mini-series, and sports programming. Turner Broadcast System's Cable News Network, United International Pictures (overseas distributor of motion pictures for Paramount Pictures Corp., and MGM/UA Entertainment Co.) and ESPN (which recently became available in Japan) are among others who have also taken advantage of Japan's growing hunger for programming.

Another advantage for foreign marketers is the enactment of new laws that have made videotape piracy a criminal offense in Japan. This new legislation is expected to reduce the practice which, along with cable piracy of motion pictures, has also been a problem in other countries in Asia such as Taiwan and Indonesia.

New Zealand

Although not quite as dynamic as the Japanese market, New Zealand's market for television programming is expanding as a result of recent deregulation of the television industry. At least four new private networks are being introduced to New Zealand in addition to two channels currently being operated by the state-run Television New Zealand (TVNZ).

A three-channel pay network, Sky Television, is also being developed. This service, providing entertainment and 24-hour news on UHF, will cover 80% of the country by mid-1991. In addition, ITV, another UHF venture, will offer programming provided by foreign investors in exchange for a 15% share in the channel.

Cable television is also being introduced to New Zealand, with as many as 12 cable networks being planned in conjunction with Telecable Holdings of the United States.

Australia

Although the Australian television industry has been struggling financially of late, it may get a boost from a proposal to raise the limit on foreign ownership of private, domestic television networks to 40 percent. The commercial networks may also benefit from a process that will combine regional stations. The newly combined stations will in turn each be affiliated with a different network.

In addition, pay television, cable, and DBS will soon be introduced in Australia, bringing television transmission to parts of the country that previously have not received any television programming. By 1992, terrestrial microwave systems will deliver 10 channels of pay television each. Also by 1992, the Australian satellite system, Aussat, hopes to introduce a six-channel DBS system, and Australia Telecom intends to offer cable by 1994.

Chile

Chile's recently elected civilian government is in the process of greatly expanding the television industry in that country. It is currently implementing a law that will create nine new privately-run stations. Currently most of the leading television broadcast stations in Chile are owned by universities. The two largest offer national service via Pan Am Sat. There is also a state-operated station.

Cable is also expected to soon spread beyond the capital of Santiago to the rest of the country.

Adding to the attractiveness of the Chilean market is the relatively low incidence of complaints of product piracy in that country.

* * *

The foregoing are examples suggesting that, just as in the more highly publicized area of telecommunications, burgeoning technology, and liberalization and privatization in the Pacific Rim, offer new opportunities for new players.

Trends in Videoconferencing

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1. ABSTRACT

The use of videoconferencing has advanced far beyond its early successful applications in the aerospace industry. This paper addresses some of the factors which are contributing to the explosive growth of this communications tool.

2. INTRODUCTION

Although Bendix/King was relatively late in the adoption of videoconferencing when it installed its first two rooms in 1986, the company has aggressively expanded the use of videoconferencing to all of its domestic and international locations. The factors which are affecting videoconferencing growth at Bendix/King in particular and the communications industry in general are:

1) Advances in video compression techniques,
2) Declining costs of video codecs,
3) Declining costs of transmission,
4) Availability of switched digital facilities,
5) Availability of multipoint conferencing, and
6) Standardization of video compression algorithms.

2.1 ADVANCES IN VIDEO COMPRESSION

In 1984, most videoconferencing applications required a transmission speed of 1.5 million bits per second. Today, many users find rates of 112 thousand bits per second acceptable. There continues to be a 2:1 improvement in picture quality (at a given speed) every 18 to 24 months.

2.2 DECLINING COSTS OF VIDEO CODECS

The main component of a videoconferencing facility is the codec. The codec converts to a digital format the analog video and audio signals originating at one end of videoconference. Then the codec compresses the 90 million bits per second digital signal as much as 1600:1 which allows the transmission over low cost digital telephone lines. At the other end of the conference, another codec reverses the process, decoding and decompressing the digital signal, then converting it back to analog. The cost of the codec is typically one-third to one-half of the cost of a videoconference room. In 1984, the codec accounted for $170,000 of a $500,000 conference room. Today, codecs are available for less than $30,000.

2.3 DECLINING COSTS OF TRANSMISSION

The transmission cost of a typical conference from the east coast of the United States to the west coast was $1500/hour in 1984. The cost of a conference at the same speed today is only $450/hour. If lower speeds are used, the reduction in transmission costs is even more dramatic. Since 1986, Bendix/King has experienced as much as a 99% reduction in transmission costs by reducing or eliminating access costs, changing transmission carriers, and using low bit rate video codecs.

2.4 AVAILABILITY OF SWITCHED DIGITAL FACILITIES

In 1988, AT&T and US Sprint introduced switched 56 services. Today, switched 56 (56 thousand bits per second) services are available in over 500 major cities in the United States. Several carriers have recently introduced or announced switched 384 (384 kilobits per second) and switched T-1 (1.544 megabits per second) services. The switched services are much less expensive than reservation-based videoconferencing services. US Sprint, for example, charges the same (approximately $6/hour) for a 56 KBPS video call over its Virtual Private Network as a voice call. As ISDN becomes more widespread in the United States and other countries, there will be further pressure on the carriers to reduce their switched rates.

Switched facilities also offer instant communications with other videoconference rooms, a vast improvement of the archaic reservation system still used by most countries. To schedule a conference from the US to Europe requires a minimum of 48 hours of advance notice. From Bendix/King's experience, a conference to Singapore requires two weeks notice. Usage will increase significantly once a conference can be held without any advanced notice.

2.5 AVAILABILITY OF MULTIPOINT CONFERENCING

The advantages of point-to-point videoconferencing have been well documented over the years. Those benefits can be leveraged several times through multipoint videoconferencing. There are a few different methods to deploying a multipoint conference among three or more sites.

One of the earliest strategies for implementing three-way conferencing is a brute force approach which is used by several aerospace firms. (See Figure 1) Each site needs two codecs, two communication lines, and an extra monitor. While each site can view both of the other sites simultaneously, the equipment costs and transmission costs are very high. The brute force approach is impractical in conferences among more than three sites.

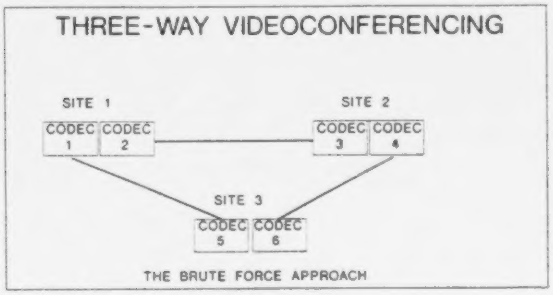
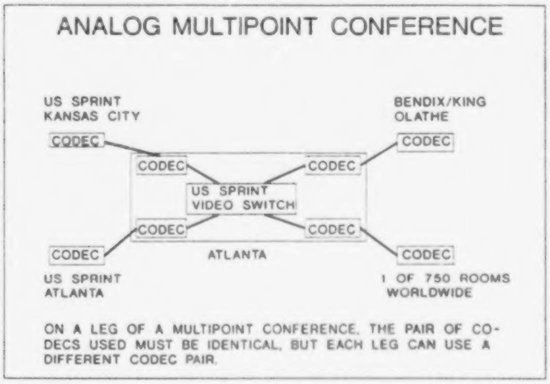

THREE-WAY VIDEOCONFERENCING
SITE 1
SITE 2
CODEC 1
CODEC 2
CODEC 3
CODEC 4
SITE 3
CODEC 5
CODEC 6
THE BRUTE FORCE APPROACH

Figure 1

Analog multipoint control units available through US Sprint offer some improvements. Only one codec and communications line is required per room, although each room can only view one other site at a time. US Sprint in Atlanta has dozens of codecs from a variety of manufacturers that can be connected to the analog multipoint controller. (See Figure 2) This configuration permits multipoint conferences with rooms with incompatible codecs. The disadvantages of an analog multipoint controller are:

1. Freeze frame graphics not possible.
2. Minor degradation of video signal.
3. Additional delay in signal processing time.
4. End-to-end encryption not possible.

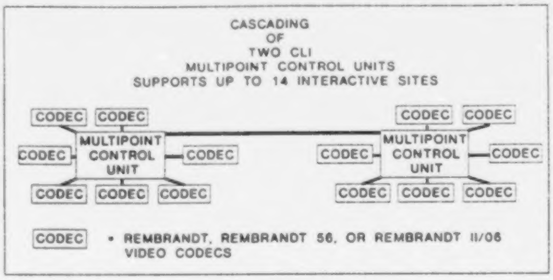
Video degradation is due to the video signal being converted from analog to digital to analog twice.


ANALOG MULTIPOINT CONFERENCE
US SPRINT
KANSAS CITY
BENDIX/KING
OLATHE
CODEC
CODEC
CODEC
CODEC
US SPRINT
VIDEO SWITCH
CODEC
CODEC
CODEC
CODEC
ATLANTA
US SPRINT
ATLANTA
1 OF 750 ROOMS
WORLDWIDE

ON A LEG OF A MULTIPOINT CONFERENCE, THE PAIR OF CODECS USED MUST BE IDENTICAL, BUT EACH LEG CAN USE A DIFFERENT CODEC PAIR.

Figure 2

A better way to handle multipoint videoconferences is with Compression Labs' digital Multipoint Control Unit (MCU). Bendix/King installed the first CLI MCU in January, 1990. The Bendix/King MCU is equipped to handle up to a five-way conference, but a single MCU can be expanded to eight sites. MCU's can also be connected together or cascaded to support up to 14 interactive sites. (See Figure 3) An MCU can also be segmented to allow more than one simultaneous multipoint conference.


CASCADING
OF
TWO CLI
MULTIPOINT CONTROL UNITS
SUPPORTS UP TO 14 INTERACTIVE SITES
CODEC
CODEC
CODEC
MULTIPOINT
CONTROL
UNIT
CODEC
CODEC
CODEC
CODEC
CODEC
CODEC
CODEC
MULTIPOINT
CONTROL
UNIT
CODEC
CODEC
CODEC
CODEC
CODEC

CODEC = REMBRANDT, REMBRANDT 56, OR REMBRANDT II/06 VIDEO CODECS

Figure 3

The multipoint control unit handles video switching in three modes. In the voice switched mode, each room views the site that is currently speaking. The speaking site sees the site of the previous speaker. When another site becomes the dominant speaker, the video then switches to the new site. To make voice-activated switching appropriate for the meeting and its participants, there are two adjustable time thresholds in the MCU. One is the minimum time required for a new speaker to be judged the dominant speaker. This can be varied from 0.1 seconds to 2.5 seconds. Bendix/King has found 0.4 seconds to be appropriate in most conferences. The other threshold is the minimum time required between consecutive switches. It is adjustable from 0.1 second to 25.5 seconds. Bendix/King prefers 3 seconds. The other two switching modes are chairperson control and lecture control. In chairperson control, the meeting moderator decides which site is the chairperson, which is broadcast to all sites while the chairperson views the previous broadcaster. In lecture control, the meeting moderator can select the site the chairperson sees, as well as which site is broadcast to the other sites.

The MCU will support Compression Labs' Rembrandt, Rembrandt 56, and Rembrandt II/06 codecs. The MCU will work with nearly 2000 currently installed codecs. Each site on a single multipoint conference must be operating at the same speed with same video and audio compression algorithms. Other conferences on the same MCU or a cascaded MCU could be running at a different speed or algorithm. For example, a three-way conference with Rembrandt codecs operating at 768 KPBS could be held simultaneously with a five-way conference of Rembrandt II running at 56 or 112 KBPS with the new CLI CTX algorithm on a single MCU.

2.6 STANDARDIZATION OF VIDEO COMPRESSION ALGORITHMS

Prior to the development of the recently adopted CCITT H.261 standards for videoconferencing compression techniques, the video codec of one manufacturer could not communicate directly with the codecs of another. The creation of H.261 has resulted in the appearance of many new manufacturers in the codec industry. The increased competition will help to reduce codec prices and thereby further increase codecs sales.

The current version of H.261 fails to address three key aspects of videoconferencing: low bit rate audio, multipoint conferencing, and graphics. The current standard allocates a large portion of the communications channel to audio, thereby producing a generally less than acceptable picture quality at speeds of approximately 112 KBPS. Any competent codec vendor can develop a compression algorithm that is superior to H.261, especially at the lower transmission speeds. Low bit rate audio, multipoint conferencing and graphics are scheduled to be added to H.261 in 1992.

2.7 CONCLUSION

Several factors discussed above are working in concert to reduce the costs and increase the utility of videoconferencing. Previous barriers such as lack of digital facilities are being eliminated while new services and products such as multipoint conferencing and standards are increasing the functionality and benefits of the medium. In a few years, it will be as easy to place a video call as it is now to place a voice call.

REFERENCES

1. Ehlers, Larry L. (1990). "Videoconferencing at Bendix/King," Teleconference Magazine, 9(2), 9-10, 33-35.

2. Ehlers, Larry L. (1990). "Bendix/King Installs CLI's Multipoint Control Unit," Teleview, 2Q.

3. Ehlers, Larry L. (1990). "Reduction of Telecommunications Access Costs of Collocation of Facilities," ITCA Teleconferencing Yearbook 1990.

4. Lill, A. (1990). "Videoconferencing; Moving From Niche Markets to Mainstream Business," Local Area Communications, Gartner Group, June 27.

THE EFFECTIVENESS OF A UNIVERSITY'S DISTANCE EDUCATION PROGRAM

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ABSTRACT

Education is now a feasible option for people for whom campus-based education is difficult or impossible. Telecommunication has removed the barriers imposed by distance and isolation. Students can now have classmates in rural and city sites, and can know the voice and face of their instructors. They can ask questions and receive immediate answers.

The author studied the effectiveness of the CSU/Chico's distance education program via ITFS system during the Spring Semester of 1989. The study investigated (a) the types of students who were enrolled in the ITFS courses, (b) the opinion of the students and instructors on significant issues in ITFS instruction, (c) the availability of institutional support services for ITFS students, and (d) the efficiency of the physical set-up of 2 off-campus classrooms and the campus classroom. The study identified the significant demographic and opinion differences among the groups of students enrolled in the ITFS classes.

INTRODUCTION

The classroom, with a teacher and students, has been the traditional site of formal education. "Classroom" implies a group of students who live near the school. In much of the world this is the case at the elementary and secondary levels. In higher education it has always been assumed that some students will move from where they live to the community that contains the school they wish to attend.

Connick and MacBrayne (1988) explain that schools must now work with adults who have needs that range from entry-level access and industrial credit courses to a full complement of undergraduate and graduate degrees. These adults do not need on-campus facilities such as dormitories or social activities. They do need access to (a) courses that can be fitted into their schedules, (b) faculty who are available when they are needed, (c) offices that are open to serve them at non-traditional times, and (d) an educational delivery system that understands the realities of the life of a busy adult who may not have the time, nor the inclination, to commute long distances, and who may not be able to afford such necessities as expensive childcare.

Most higher educational institutions were founded to meet the needs of 18-22 year old students. Their function is different today. Universities are now a part of a vast educational industry that must service a wide range of needs and ages.

Distance education courses should be available at all levels and in most disciplines. Other needs must be met--those of industry, local and state government, the health services, entertainment, and religion. A complex system of technical equipment is needed both for the provider and the recipient of distance education programs. This puts the cost of the production beyond the means of most single institutions.

Distance education has become a free market enterprise. Holt (1989) warns educators that "today's students are sophisticated, are used to high quality commercially produced programs for television, and look for maximum value for what they pay" (p. 58).

University-based vendors of programs must compete with independent consortia already operating successfully. Tinsley (1986) reports in a survey evaluating the TI-IN Network, Inc., the first private satellite based educational system in the U.S.:

> Today, high schools located in rural districts, such as Dime Box, Texas, are successfully participating in credit bearing courses not before available.... TI-IN offers an alternative for overcoming geographic and curriculum limitation. Factors of compatibility, ease of use and cost effectiveness, may explain why more administrators are adopting TI-IN. (pp. 15-16)

In the U.S. and elsewhere, universities have joined with other organizations to form consortia. Within such structures, finances, expertise, and production capacities can be organized economically. Quality programs can thus be produced cheaply to meet the needs of discerning learners who now have choices between the products of several vendors.

The technical efficiency of nationwide communication systems, and the ability of vendors to produce quality programs should make it possible for all adult students to find a program to suit their needs. It could be assumed that students would be highly satisfied to be freed from the constraints of campus programs while receiving quality courses of their choice. A 1983 survey of off-campus students at Queensland University in Australia showed, however, that the majority of students seem to be saying that they would prefer to study in a mainstream campus environment with a degree of teacher support and peer group support that this is assumed to provide (Kelly, 1986).

This indicates that a study of student opinion could be worth pursuing, since "the continuing growth of the distance education depends upon the audience being served, and the market is certainly need-driven and highly entrepreneurial" (Holt, 1989, p. 58).

The Context of this Study

For 16 years I worked in Queensland, Australia where fewer than 2.3 million people live in over 1.7 million square kilometers. Distance creates educational disadvantages at all levels for 25 percent of the people. Therefore, the Department of Education has always needed to deal with the problems posed by distance.

In 1960 "The School of the Air" crystallized out of earlier experiences to deal with the problems of mainstream education up to the high school level. Rayner (1949) states that "Australia can claim to be the first country to have systematically demonstrated on a large scale that it was possible to provide a complete correspondence education for primary and secondary students who had never been to school" (p. 12).

The success of the 'Australian model' has been largely due to the flexibility of the correspondence method in relationship to the life style of the people. It was particularly suited for those people in the out-back whose movements and responsibilities are governed by such factors as extremes of weather, the cycle of station life, seasonal employment, and a semi-nomadic life style.

The University of Queensland has provided for the needs of teachers in the State since 1911. External courses make it possible for teachers serving their mandatory period in remote areas to up-grade their qualifications. This upgrading is essential for promotion.

In 1980, the Institutions of Higher Education in Queensland established a coordinated system of external studies that offered courses in selected fields to meet the needs of distant students. This is a decentralized system that "takes advantages of existing expertise, facilities and organization to increase access to advanced education throughout the State" (Store & Chick, 1984, p. 57).

In spite of the new coordinated system and increased technology, external studies progresses slowly. Lack of resources is a severe constraint. A more important limitation is caused by under-utilizing or misunderstanding the services that are available. The support network, the organization of courses, and the operation of the regional centers would benefit from critical re-evaluation (Gough, 1981).

The fundamental problem facing all distance education planners is to find the most effective "mix" of new technologies, old systems, professional expertise, and student requirements. Eastcott and Small (1984), quoting from a resolution passed by The Professorial Board of the University of Sydney in 1951, stated that:

> External studies are necessarily greatly inferior to internal studies and even with the most carefully organized and well staffed external department so little can be achieved and that so imperfectly that the establishment of external studies cannot be recommended. (p. 64)

The growing cooperation between institutions has done much to discredit that statement, but even 37 years later universities and other educational establishments need to look critically at the efficiency of delivery systems. Students, particularly mature students, are becoming increasingly aware that communication techniques used by commercial enterprises are more effective than those generated within traditional institutions.

Background of the Study

My experiences in distance education in Queensland, Australia provided the initial impetus for this study. Those experiences helped me to understand the real problems that distance learners face when they seek formal education. I was aware of various existing Australian approaches to distance education--the School of the Air, Extension Courses from the University of Queensland, and a wide range of Technical and Further Education courses.

I heard Dr. Charles Urbanowicz at the 1988 Pacific Telecommunications Council Conference in Hawaii enthusiastically describe how California State University/Chico is successfully using the Instructional Television Fixed System. The geographical situation in Northeastern California seemed roughly similar to Northwestern Queensland, where James Cook University services the needs of a widely scattered population. I decided to investigate the use of ITFS more thoroughly.

It seemed that this particular system had many advantages for both educators and students. The technology used was simple, familiar, and reasonably inexpensive. Almost everybody uses television, and telephones, and a microphone is not a strange device. Further, ITFS makes simple demands on technicians.

Distance education system must meet the needs of many different learners. My particular interest was with adults who, for a variety of reasons, could not become regular campus students.

The ITFS system as described by Dr. Urbanowicz (1988), took the loneliness out of distance education by providing interactive classrooms at sites that would be accessible to a number of students. These classrooms provided a reasonable approximation of a regular university classroom. Students from the community serviced by each site could meet regularly, get to know each other, and ultimately obtain the peer support that students need. Although the ITFS instructors are not physically present, the students could easily contact them via the microphone/telephone, and have immediate feedback to comments and questions. The instructor's face, mannerisms, and teaching styles would become as familiar to off-campus students as they are to the on-campus students in the classroom. Instead of participating alone at home, these off-campus students could feel part of the on-campus action when the instructor was teaching.

Lack of funding is generally a severe constraint for innovative programs at most universities. Consequently, the only feasible technologies are those that are cost effective, efficient in reaching the intended audience, and likely to offer more advantages than existing methods. ITFS appeared to meet these criteria very effectively. It also had other desirable attributes, such as, (a) new sites could be set up at reasonable expense, (b) off-campus students could be taught by highly qualified campus instructors, (c) simultaneous off/on campus teaching would maintain the university's academic standards, and, (d) off-campus students would share the facilities and support services available to on-campus students.

I visited CSU/Chico to meet Dr. Urbanowicz, and to see the physical environment of the Chico Program/facilities. The other faculty members that I met were equally as enthusiastic and proud as Dr. Urbanowicz was of the university's work in distance education. Since the Spring of 1975, when the system began, over 400 courses had been delivered via ITFS to over 2,200 students, providing choices that could not have been possible in a normal extension type system. For the Spring 1989 semester, 23 courses were planned for 16 sites, and it was anticipated that the increasing demands from distance communities would lead to further expansion.

My proposal for a study of the effectiveness of the CSU/Chico's ITFS program was supported by the Dean for Regional and Continuing Education and other members of the ITFS faculty. The Spring 1989 semester was selected as the appropriate time to study the students and faculty, and their reactions to the technology that constitutes the ITFS system.

The study gathered data through three instruments: a questionnaire administered to 288 off-campus and 386 on-campus students, interviews with 10 ITFS instructors, and nine class session observations.

Appropriate data analysis techniques were used to assess the significance of differences in the quantitative data, and the relative values of qualitative data.

SUMMARY OF PRINCIPAL FINDINGS

Compared to on-campus ITFS students, significantly more off-campus students were female, older, married, and employed. They lived an average of 86 miles from the campus, but all had used some of the key campus services/facilities during the semester. This was the seventh ITFS course for the average off-campus students.

Both off/on-campus students generally agreed that ITFS provided the only practical way to take the course, and that the class they took met at a convenient time.

Both off/on campus groups were generally moderately satisfied with the ITFS course design, teaching, student/instructor interaction, class discussion, and the sense of community that developed within the class group.

Both off/on campus student groups were generally satisfied with the equipment, the way it was used, and the quality of graphics, but they were not satisfied with the back-up plan for equipment failure.

The instructors seemed moderately pleased with the ITFS system, but sought improvements in their relationships and out-of-class interactions with the off-campus students. They also felt inhibited by the technical limitations of the current facilities and equipment.

The university's ITFS system seems to succeed in its goal of delivering many courses to distance students who would otherwise have had limited access to upper-level courses. The limitations of the system emerged in the findings, but the overall assessment was positive.

Conclusions

The findings of this study and the review of the literature suggest the following conclusions and related educational implications.

The literature in the field indicates that distance education programs appeal to students who differ demographically from regular on-campus students. The findings from this study reported that the demographic characteristics of the off-campus students paralleled those described in other research reports on distance education. The off/on-campus students were in the expected range of differences in age, gender, marital status, and employment.

This study did not seek detailed information about the off-campus students but the demographic data suggest that the study group probably includes white-collar and blue-collar workers, single parents, working mothers, managers, sales people, night shift workers, disabled and retired people, and others who cannot leave home for long periods of time. Many off-campus students, and particularly the younger ones, may need or prefer the security of a full-time job and part-time study to full-time study financed by parents/savings/loans.

Schools providing for the educational needs of such a heterogeneous group of students should take a business-like approach when they plan programs, since students support for such programs depends upon their level of satisfaction. This suggests that the university should understand the nature and expectations of potential ITFS students. It is important to include upper-level courses in such programs, but an effective educational program must also provide counseling services, opportunities for working with peers, access to learning and research material, and opportunities for student interaction. This study found that ITFS was successfully meeting those needs.

Instructors in distance education teach students with a wide variety of educational backgrounds, from people with less than a high school education to those with a university degree. The off-campus students' study skills may be rusty, non-existent, or unsuitable, and it may be difficult for them to find time for study. Therefore, distance students need quality teaching that helps them to overcome their problems and ensure that their expenditure of time and energy is not wasted. CSU/Chico seems well aware of the needs of off-campus students, and produces advisory material for ITFS instructors. The off-campus students responded favorably to Chico's program, and indicated that it provided teaching suited to their requirements.

ITFS technology has enabled the university to move out of its Chico neighborhood and create a campus without boundaries. Both off/on campus student in this study were able to reach class in about 16 minutes. ITFS classes operate from 9:00 a.m. - 10:00 p.m. Monday through Friday, and 9:00 a.m. - 3:00 p.m. on Saturdays, thereby, offering choices to suit students who may be employed and/or have other obligations.

This study found that ITFS provided the only real options for many off-campus students who needed upper-level courses to meet major or professional requirements. The off-campus students obviously appreciated this opportunity since they had completed and average of six ITFS courses before enrolling in their current course.

Reports in the literature indicate that distance educators must become more entrepreneurial. It is evident that a rapidly growing student body of life-long learners is emerging, since personal development is the second most important reason the literature reports for taking distance education courses. Only about one-tenth of the off-campus students indicated that they took the course primarily out of interest. However, the trend is there, and it seems likely that CSU/Chico's ITFS program will provide a means for more northeastern Californian students to have the personal enrichment that they desire.

One of the strengths of the CSU/Chico's distance education program is that off-campus students meet in an environment that provides a reasonable approximation of a regular classroom in a school setting. It is essential that the planners of distance education programs remember that the classroom environment contributes to the quality of group learning.

In this ITFS situation the equipment for receiving lessons and participating in discussions is essential but, what is equally important, is that the environment should provide what distance education students often miss--the sharing of experiences with a group of peers, meeting outside of class for social conversation or discussion of the lesson, the feeling of being among students who are "going to school." The choice of sites in the Chico experience certainly promotes such a feeling of "belonging" since most of the classes meet in schools, colleges, and other educational buildings, where other classrooms and students help create a general academic atmosphere.

The scaled opinions of the off-campus students about their ITFS experience tended to range between moderately satisfied and moderately dissatisfied. This is the kind of rating that could be expected from students who are into their seventh ITFS class. The initial euphoria of novelty and gratitude appears to be replaced by a comfortable acceptance of a system that does what it is expected to do. The students are neither highly enthusiastic nor highly critical. It appears that ITFS has become a familiar provider of educational needs for off-campus students, and is doing what the students expect it to do.

Students who are generally mature and earn a living expect some trade-off for every expenditure of time, energy, and money. If ITFS had not provided a satisfactory return to students who had to sacrifice in order to study, the system would not be expanding at its current level. The quality of the course design and teaching must compensate off-campus students for the fact that they learn in a classroom without an instructor physically present, and also for the other luxuries/interests/relationships that they have to deny themselves in order to become students.

The key factor revealed by this study is that the basic program is good from the point of view of students and instructors. Technical problems will be solved in the future when the university can commit enough funds to provide state-of-the-art technology. Whether that should be the priority is debatable since ITFS seems accepted, in spite of its current limitations, as a successful provider of distance education. Other communities not yet served by the system can easily and economically be linked into the existing network. It seems more reasonable at this point to provide access to more people than to concentrate on the up-grading of the technology, but that is a political issue beyond the focus of this study.

REFERENCES

Connick, G.P., & MacBrayne, P. (1988). Educational access and telecommunications in Maine. Paper presented at the Tenth Annual Conference of the Pacific Telecommunications Council, Hawaii.

Eastcott, L., & Small, I. (1984). New South Wales: Getting the mixture right. In K. Smith (Ed.), Diversity down under (pp. 64). Queensland: Darlingdowns Institute Press.

Gough, E. (1981). Distance education at Deakin University and University Sains Malaysia. Open Campus, 3.

Holt, S. (1989). The future according to pogo. The: Technological Horizons in Education Journal, 16(6), 58-62.

Keegan, D. (1986). The foundation of distance education. London: Croom Helm.

Kelly, M.E. (1986). A survey of use and evaluation of support services by external students. Working papers in Distance Education, No. 10, School of External Studies in Continuing Education. Queensland, Australia: University of Queensland.

Rayner, S.A. (1949). Correspondence education in Australia and New Zealand. Victoria: Melbourne University Press.

Store, R., & Chick, J. (1984). Reaching out in Queensland: A decentralized approach. In K. Smith (Ed.), Diversity down under (pp. 57-62). Queensland: Darling Downs Institute Press.

Tinsley, P.S. (1986). Reaching rural schools using an interactive satellite based educational: Evaluating TI-IN Network's first year. Paper presented at the Annual Conference of the National, Rural, and Small Schools Consortium, Bellingham, WA (ERIC Document Reproduction Service No. ED 016101).

Urbanowicz, C., Wright, L.J., & Meuter, R.F. (1988). Educational telecommunications from California: A case study from California State University, Chico. In D.J. Wedemeyer & M. Ogden (Eds.), Pacific Telecommunications Council Tenth Annual Conference proceedings (pp. 65-69). Hawaii: Pacific Telecommunications Council.

Effectiveness of Distance Learning by Telecommunications

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Abstract

Statement and agenda for working group discussion at PTC '91. This brief paper comments on the need for wide-ranging discussion on the topic of educational telecommunications and its effectiveness when used as a delivery mechanism for distance learning. It points out that two goals must be achieved: the experience of the past must be consolidated, and the future must be addressed by provision of clear guidelines on issues such as policy, educational/cost effectiveness, legislation, and alternatives.

Telecommunications has been used as a delivery mechanism in distance learning for a period of forty years. Soon after the invention of radio, educators realized the potential for delivering education to a learner located at a distance from the information provider. Each telecommunication innovation since radio has continued to expand the potential for distance learning. Point-to-point satellite, broad-band fiber cable paths, integrated systems digital networks, and computers join forces to produce incredible delivery potential for those interested in reaching the distant learner. However, educational telecommunications has failed to keep pace with other users of telecommunications such as business, entertainment, and industry. Educators have maintained a basic insecurity concerning the effectiveness of learning via telecommunications versus traditional modes.

Telecommunications as a delivery mechanism has blossomed in a number of educational institutions around the world. Incursion of educational telecommunications into the domain of traditional education practice has occurred largely in the post-secondary sector due to the burgeoning need for training and retraining, as well as the ever increasing pressure of individuals demanding opportunities for life long learning. Yet, with a few notable exceptions, the majority of educational institutions using and adopting educational telecommunications for delivery of learning are doing it on a one-shot or experimental basis. The educational establishment, from university presidents to elementary school teachers, holds telecommunications suspect as an effective, cost-efficient means of facilitating learning. A major task confronts those involved in educational telecommunications in presentation of a convincing argument substantiating the educational soundness and cost-effectiveness of telecommunications. Two goals must be achieved in that the experience of the past must be consolidated and the future must be addressed by provision of clear guidelines on issues such as policy, educational/cost effectiveness, legislation, and alternatives.

Many PTC '91 attendees are on the "frontline" when it comes to provision of learning opportunities by means of telecommunication. The industry would be well served if those individuals who are involved in delivery of education by telecommunications, or a hybrid including telecommunications, were afforded an opportunity to engage in discussions about the effectiveness of their programs. Sharing of experience would be beneficial in that it may reduce the feeling that is prevalent among program providers that delivering effective education by telecommunications is still at the experimental stage. In the long term this working group could be instrumental in sharing vital information with a much broader audience.

Some questions which may be posed by the Effectiveness of Distance Learning by Telecommunications Working Group are as follows:

1) In what type of educational telecommunications endeavor are you engaged?

2) What is(are) the objective(s) underlying your distance learning program and what is the the nature of the client base it serves?

3) Are you aware of and can you describe the rationale that promoted the use of telecommunications in the delivery of your distance learning program?

4) Was a needs analysis carried out prior to initiation of your program? Has an account of the needs analysis been preserved and how could an individual or agency access this documentation?

5) Has on-going evaluation been in place to assess the effectiveness of your program? Have assessments been carried out that address cost-effectiveness, learner satisfaction, and attainment of institutional goals?

6) What is your personal assessment of the effectiveness of educational telecommunications by itself or as part of a hybrid system in delivering education to the distance learner?

Lessons drawn from 2 existing regional satellite networks: ARABSAT and EUTELSAT. Application to the Pacific Basin projects.

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06322-CANNES, France

1. ABSTRACT

Two regional satellite networks have been in operation for more than 5 years "ARABSAT and EUTELSAT". After a brief description of each system, the current use of their payload is reviewed and compared with their respective planning stage predictions. From this perspective, some teachings are drawn which could be profitable for emerging regional Pacific Basin networks, now in the planning stage.

2. DESCRIPTION OF TWO EXISTING SATELLITE NETWORKS

2.1 ARABSAT

This network belongs to the ARABSAT organization which includes more than 20 countries of the Arab League.

A contract was signed with AEROSPATIALE as prime contractor in 1981 for the construction of 3 spacecraft. The first two were launched in 1985 i.e. ARABSAT 1A with ARIANE in February 85, ARABSAT 1B with U.S. shuttle in June 1985. The third model, ARABSAT 1C will be launched in 1991 with LONG MARCH.

The payload consists in 25 channels at C-band (33 MHz bandwidth each) plus an S-Band channel. The nominal coverage as shown in figure 1 is a shaped beam at C-band and an elliptical area at S-band.

The edge of coverage EIRP at C-band is 31dBW (center : 34 dBW) and 41 dBW at S-band (center : 45 dBW). 1A is located at 19° East longitude, 1B at 26° East (see coverage at figure 2) and 1C will be positionned at 31° East on the geostationnary arc.

The main ground control station is located near Ryadh in Saudi Arabia while a back-up station is situated near TUNIS in Tunisia.

2.2 EUTELSAT

The EUTELSAT organization is based on the INTELSAT model, its membership being limited to European PTT's. Presently 8 countries are involved. Its space capacity includes two generations of satellites.

The first one, EUTELSAT I, is composed of 4 spacecraft, launched between 1983 and 1988. Each satellite includes up to 12 Ku band channels covering Europe in 3 spot beams (fig.3) with an EIRP of 39 dBW at the edge (45 dBW at center).

The second generation, EUTELSAT II, will be composed of at least 6 satellites contracted with AEROSPATIALE as prime contractor.

The first one has been launched in August 1990 with ARIANE. Its payload consists of 16 Ku-band channels with higher EIRP.

The coverage (figure 4A and 4B) can be switched between a large European area, with an edge EIRP of 44 dBW and a narrow central Europe beam, with an edge EIRP of 50 dBW (center 53 dBW). This flexibility is available by ground command to any channel. The satellites are controlled from the headquarters of the organization located in Paris, France.

3. CURRENT USE OF THESE NETWORKS

3.1 ARABSAT USAGE :

As of November 1990, ARABSAT 1A was used by several Arab countries while ARABSAT 1B is leased to India which occupies four half-transponder channels for Indian Television. In ARABSAT 1A, 5 channels are occupied by full-time national television programs of Saudi Arabia (2), Oman, Morocco and Mauritania while 2 more are used for occasional-use TV service.

Concerning regional Telephony (FDM/FM or SCPC traffic) present loading is about 35% of the capacity set aside for this purpose. Domestic telephony loading is also low as compared to capacity.

Finally, the S-band channel has been switched on in November 1990 with a regional TV program produced in Egypt.

3.2 EUTELSAT CAPACITY USAGE

Here is a list of capacity loading (see fig.5)

EUTELSAT I at 7° East :
4 TV channels /4 Telephony/2 for data transmission (called SMS)

EUTELSAT I at 10° East :
5 TV channels

EUTELSAT II at 13° East :
9 TV channels

EUTELSAT I at 16° East:
Regional TV (EBU)
TDMA telephony

Out of the total service revenues, television services account for 75%. (see figure 6)

4. COMPARISON WITH DESIGNER PROJECTIONS

Clearly the importance of television services from these networks was under-estimated at the time of their design.

This occured in the late seventies, when television in Europe was still ruled by state monopolies; the situation changed fairly abruptly in the early 80's.

Ten years later, most European Countries have given up their television monopolies and scores of commercial television companies are eager to reach the wide audience accessible via satellite transmission.

This trend explains why EUTELSAT decided to have in its second generation satellites, (designed in 1985), more channels with higher power and more coverage flexibility.

Competitor satellite networks vying for the same TV-oriented business have sprung up in the meantime particularly the privately-owned, Luxemburg based,ASTRA. The geostationary arc over Europe is now densely occupied and room will be scarce for newcomers.

South of Europe, in the Arab states,the national television monopolies did not break-up, moreover law-makers there are inclined to bar Western style television programs from reaching the general public. Therefore ARABSAT did not undergo the tremendous TV capacity demand increase observed with EUTELSAT.

Moreover, concerning ARABSAT telephony which was the predicted backbone service, three parameters hindered loading developments :

- the communication ground antenna in the various member countries were put into service very slowly and generally several years after theoretical start of the system.

- the rates are comparable to, rather than competitive with, INTELSAT.

- contrary to expectation there is not a high degree of inter-Arab traffic, most of the traffic appears to be going over INTELSAT to other countries.

In the case of EUTELSAT, advanced regional digital telephony and business services including VSAT networks and teleconferencing were predicted to be the largest revenue making services at the system design stage (in the late seventies). This proved to be wrong (see figure 5) and the slow start of this type of traffic was partly due to the high fees asked for teleconferencing and high bit rate data transmission. (The lower bit rate data transmission, using small amounts of bandwidth, hardly account for sizeable loading).

5. SITUATION IN THE PACIFIC BASIN

In the Pacific Basin several private and governmental regional satellite networks either newly existing or in the design phase are vying to deliver services to potential customers. These services include national Television, commercial Television, VSAT networks, and regional or domestic telephony.

The countries involved in most coverages of these systems are not as much related as say European Countries on one side, the Arab States on the other.

For example the legislation for television provision is very different in Burma/China and Thailand/Taiwan - all countries included in the coverage area of ASIASAT 1.

Still, Television is considered as the most promising money making service, while point to point telephony has to keep into account the competition of optical fibers in the most developed states. Otherwise VSAT networks will only interest fairly developed nations and many of these networks are needed to fill up a transponder while only one is necessary with Television (a 36MHz wide transponder is assumed).

Although happening in another part of the world, the experience gained with the two regional systems described previously, ARABSAT and EUTELSAT, should be used to lay down some general principles.

Therefore the following considerations should be kept in mind for those in charge of designing the payload of future similar satellite systems or trying to assess potential markets.

- Television is likely to be the backbone service for capacity loading and revenue making.

- Countries with liberal TV provision policies should be marketed heavily.

- Set the transponder lease rate at a competitive level with respect to INTELSAT.

- Catch the market of world wide TV network (e.g. CNN)

- Do not expect telephony either trunk routes or thin routes to take up much loading (Major routes are already installed with optical fibers and thin route is hardly a contender to fill up capacity.)

- Also, communication ground station availability has proved to take time and alter many a business plan.

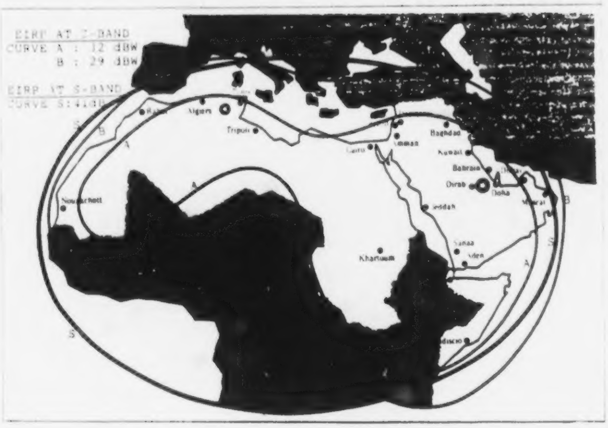
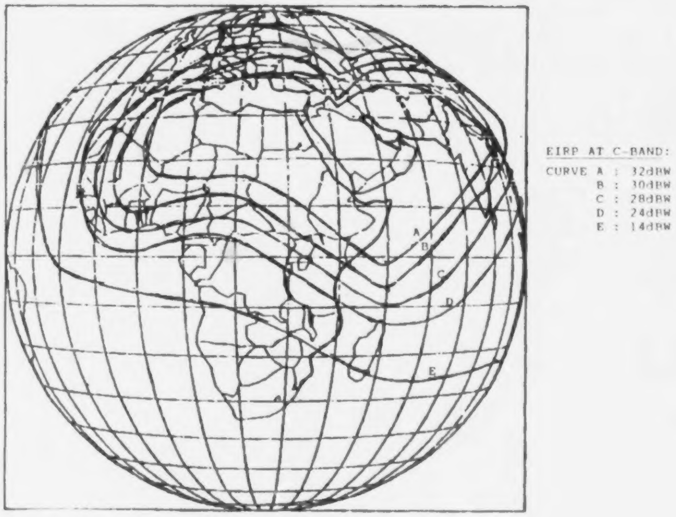

EIRP AT C-BAND
CURVE A : 12 dBW
B : 29 dBW
EIRP AT S-BAND
CURVE S:41dB
Rabat
Algiers
Tripoli
Cairo
Amman
Baghdad
Kuwait
Bahrain
Dirab
Doha
Nouakchott
Jeddah
Sanaa
Aden
Khartoum
A
B
S

Figure 1
ARABSAT 1A Transmit coverage

Figure 2
ARABSAT 1B transmit coverage


EIRP AT C-BAND:
CURVE A : 32dBW
B : 30dBW
C : 28dBW
D : 24dBW
E : 14dBW
A
B
C
D
E

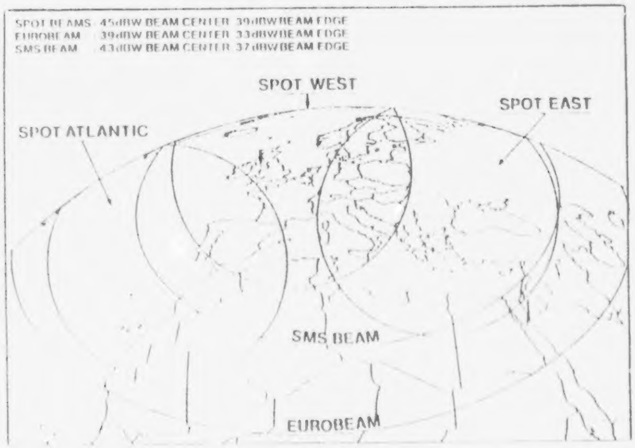

SPOT BEAMS 45dBW BEAM CENTER 39dBW BEAM EDGE
EUROBEAM 39dBW BEAM CENTER 33dBW BEAM EDGE
SMS BEAM 43dBW BEAM CENTER 37dBW BEAM EDGE
SPOT WEST
SPOT EAST
SPOT ATLANTIC
SMS BEAM
EUROBEAM

Figure 3
EUTELSAT I (first generation)
transmit coverage

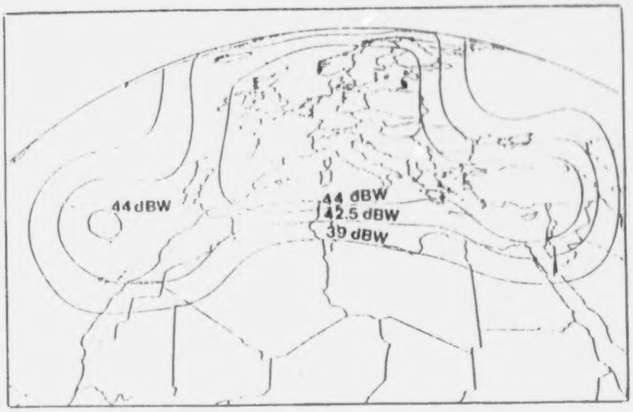

44 dBW
44 dBW
42.5 dBW
39 dBW

Figure 4A

EUTELSAT II (2nd generation) transmit coverage Wide beam

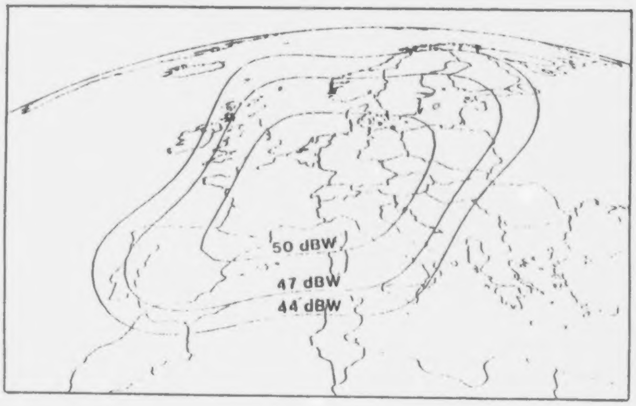

50 dBW
47 dBW
44 dBW

Figure 4B

EUTELSAT (2nd generation) transmit coverage Narrow beam

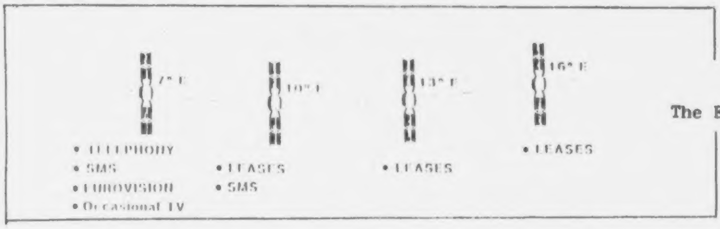

7° E
10° E
13° E
16° E
• TELEPHONY
• SMS
• EUROVISION
• Occasional TV
• LEASES
• SMS
• LEASES
• LEASES

Figure 5

The EUTELSAT space segment (end 1990)

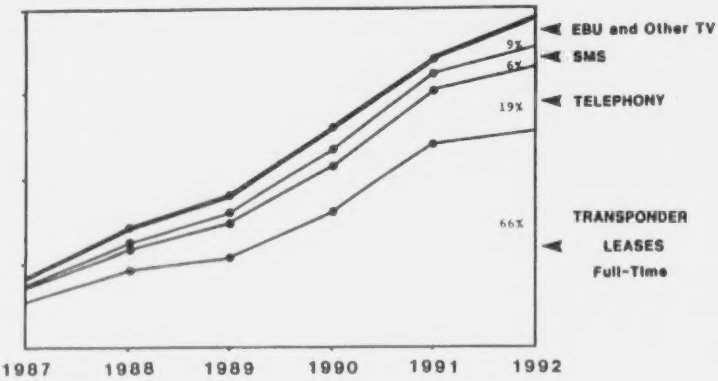


Figure 6

EUTELSAT business revenues

NETWORK MANAGEMENT ON A GLOBAL SCALE

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ABSTRACT

This report is designed to help the reader better understand the global communication network environment. It looks at various forces that affect networking as well as the different management styles and options utilized to effect efficiencies. Highlighted are management tools and options available to utilize in the creation of a cost and operationally efficient network, of any type, anywhere.

Networks are a series of communications links that connect large numbers of government employees to each other. These networks may transmit voice, data or combinations thereof. To manage these unusually complex assemblages requires more than just finding appropriate products to support, control, and operate them. To be successful, network managers must develop certain unique management skills and insights that are, quite frequently, unrelated directly to networking.

When it comes to network management, the users look for the user friendly service that will most cost effectively meet their needs. A manager requires other things beside cost, however. They require ease of handling, cost effectiveness, operational efficiency, user friendliness and tools that will enable a smooth operation. Managers also have other considerations, such as personnel, administrative, and fiscal concerns, as discussed later on in this report.

FUNDAMENTALS

Network managers are continually weighing "needs" vs. "wants." When a "need" exists it means there is a requirement for some thing to provide relief. A "want" on the other hand, represents an implied need, something you want but may not really and truly need to fill a gap. A competent network manager can waive aside "wants" most of the time while directing his or her limited resources toward real "needs."

Networks are managed either a remote or centralized approach. The hundreds of voice and data networks that comprise the government environment appear to be centrally managed at first glance. This is technically correct because each network has a centralized management group. However, the government is actually one great big user, an admittedly large one in today's technical environment, all these myriad networks and their associated needs, could conceivably be served by one overall network and its management team.

Centralized network control reduces administrative costs and can capitalize on the circuit engineering concept of "... the more traffic on a circuit route, the more efficient is each path," saving hardware dollars as well. Two good examples of this theory are the Defense Metropolitan Area Telecommunications Systems (DMATS) in Boston and San Diego. These DMATS utilize the concept of circuit consolidation for economy in a most successful way. The WITS (Washington Interagency Telecommunications System) promises to be cost effective utilizing this concept.

Recently, GSA recognized the seriousness of this cost saving potential and developed the FTS 2000 Network Plan. This plan will not only revitalize the existing Federal Telecommunications System (FTS) as shown in Exhibit I, but will also consolidate other existing and planned networks.

PERSONNEL ISSUES

The central vs. decentralized management issue is a major factor in network management. Each network manager has or will someday face the time when he/she must decide which approach to choose in a network development program. Recent trends lean towards centralization. The personnel concerns in this issue are numerous. For example, where will the people be located, who are designated to operate each segment, who will lead the group, and when will they be required to consult with headquarters?

If network operations staff are not located in or near a large city, it will be harder to manage them properly. Visiting logistics are more difficult for remote locations. It is also more difficult for the remote users to receive proper attention from technical service staff distance discourages the rapport that comes from periodic personal contact which, in turn, produces a certain empathy.

The U.S. Navy operates a large facility in South Central Indiana called the Crane Naval Weapons Center. This facility is a full day's travel time away from the Philadelphia base which supervises telecommunications operations. Periodically, the Navy Facilities Engineering Commands in Philadelphia was required to visit all the facilities they supervised, such as Crane. Reviews and personnel matters had to be considered on a regularly scheduled basis and, needless to say, proved to be extremely difficult.

Senior officials should closely examine responsibility and organizational structures to avoid these circumstances, unless there are specific technical reasons that take precedence. In summary, when examining or planning for a decentralized organization, look at the geographics of the arrangement finalizing and implementing your plans.

Planners must closely examine Organizational structures near the beginning of the cycle for operability and usability. Once an employee is placed into a job at a job site, there are many reasons that make it difficult, if not impossible, to change either that person or job location. A few examples of personnel difficulties include: children are placed in school systems where they assimilate themselves and parents are reluctant to take them out; wives/husbands also work and are then reluctant to leave their jobs. The bottom line in personnel goals is stability -- a direct result of good planning.

Civil Service rules and regulations are a good moderating influence on hiring, firing, and relocations. They perform this function by being extremely deliberate in their practices. This allows the hiring agency more time than they may feel is necessary, but the delay may eliminate rash decisions.

The hiring experience of Civil Service has been well documented over the years. They provide proven guidelines for fairness in hiring and usually provide workers with capabilities for long term employment. The telecommunications network management challenge lies in the areas of leveling workloads and motivating professional telecommunications people to perform well over the years.

Preliminary budget planning for the fiscal year begins in the second and third fiscal quarters of the preceding year, precipitating the need for long term planning. After the year begins there is a reassignment of some funds call residuals. There are funds that are expected to remain at years end. This doesn't always happen, but when it does, this is a great opportunity for us to make use of dollars we didn't plan on having available. Residual funds come from leftover money that was assigned for a specific project that was canceled or didn't use all the funds allocated. The budget tightening that has taken place over the past few years causes more care to be taken in planning which means starting earlier.

To accomplish accurate forecasting you require appropriate documentation. There are several ways to gather this information; for example talk to people involved and study telephone traffic where the appropriate traffic exists. It is remarkable what information is available on telephone bills! Not only is there a cost for a call but at least a dozen other bits of valuable information that can be used in network traffic studies.

"Community of interest" is one of the most valuable pieces of this puzzle. Looking at a telephone bill, a skilled observer can identify not only the cost of telephone calls but the quantity, length and concentration of importance to the study. To perform a traffic analysis it is necessary to review the calling data very thoroughly. There are software programs available to allow someone designing or planning to design a network to gather actual call data and massage it in various ways. It can be combined with data from other potential network locations which allows for interesting study capabilities. This capability is very expensive but greatly helps in performing the necessary network studies in a more timely fashion.

If a study is done with data that has become outdated, for one reason or another, it is worthless. Until Telco Research of Nashville, Tennessee came out with Network Optimization Software in the 1970s, it was a very chancy and tedious problem to attempt developing a network. AT&T had procedures available for their use only, that they would use to help you, but most people are better if they could do it themselves. The birth of Telco Research was, in my opinion, the beginning of large usage of private networks in this country.

When the tools became readily available for the user to be creative, you began to see the migration from simple point to point and tandem tie line circuit groups into true networks. The material became available to allow the development of standards for network architecture and performance. With those standards and the approaching divestiture ruling, people saw a need for a system of true standards and procedures in the field of telecommunications. As January 1984 approached, communicators saw the demise or at least the contamination of the existing de facto standards as developed over the years by AT&T. The FCC also saw this situation developing sanctioned the American National Standards Institute (ANSI) to address it.

ANSI's first meeting took place in 1983. The group formed many supporting enclaves composed of industry related representatives who were each assigned a portion of the work in this most complex of industries. The people involved in standards making come from all aspects of the industry, filling positions on the standard making group or organization they feel is most relevant to their background and business needs.

The most prominent of these organizations is Committee T1 which is sponsored by the Exchange Carriers Standards Association which in turn is accredited by the American National Standards Institute. T1 consists of 23 working groups (Exhibit I). There are six major groupings for the committee, each with a special area of consideration. Technical Subcommittee T1C1 is responsible for issues relating to Carrier to CPE Interfaces. T1D1, Integrated Services Digital Networks and T1M1 Internetwork Operations, Maintenance, Administration and Provisioning are both in full swing at this time while T1Q1 (performance parameters and levels), T1X1 (carrier to carrier interfaces) and T1Y1 are just chugging along.

With a complete rewrite of industry standards taking place and the Committee T1 being only one of several interrelated groups involved, it becomes increasingly clear that the government network manager has a tough and complex job.

Speaking of a tough job, let's look briefly at some of the fiscal issues the network manager must deal with. First there is the annual budget. It is extremely important to project an accurate figure for the following year because it is so difficult to get a supplement. In direct contrast, it doesn't look good on your annual review either, the fact that you had a dramatic under run. The only saving grace in this situation, is if you can attribute the over run or shortfall on a substantial unplanned event.

The annual review form GSA Region III uses, rates individuals on their planning ability.

The cost of running a network doesn't only include hardware. The lines and switches do make up a large part of the costs, but so does manpower. Usually in an organization of this type there are people that manage the network, billing people, one or more planners and sometimes a network control center and the appropriate people to operate it. The exact head count and job assignments vary with each operation.

In the late 1970s, before the trend toward centralization, Naval Facilities Engineering Command had purview over almost three dozen small networks within their Northern Division Area alone. They consisted of several one and two person operations all the way up to several complex networks involving many sites with large numbers of persons working on the net.

Billing the user for being able to use a network is as flexible an option as there are manners of billing. The variables number as high as the number of networks involved. Some managers feel it is too costly for equipment and manpower by the number of departments or groups using the net. Other operations bill for each minute of network use plus the fixed costs divided by each department. Even other network cost divisions allow the inclusion of only actual charges for Off Network access line calls as well as third party calls. Again, the options are unlimited.

The type of billing for network services is generally related to the way those services are budgeted. If a standard amount of money is being brought in from collections, the manager can plan on that amount of flexibility in the budget. Some government networks don't collect for non business calls for example, thus have different collection rates. FTS forbids non business use on its lines, so that operation can't collect for that type call. Other government networks plan on a 15 to 20 percent personal call rate. If they collect a third of that amount, they could have a substantial pot of funds to use by the end of the year (i.e. 5% of $100,000 = $5,000).

Another cost factor involved with networks, due predominantly to their complexity, is consulting and their associated fees. Every once in a while, it is prudent to hire an outsider to look at any one, several or even all aspects of your operation to verify its efficiency. This service will cost a fee that can be amortized over the whole network or charged directly to a specific account or part of the operation. Managers must remember they are the controlling factor. They can decide how and where to apply costs. All that is required is a reasonable justification.

Budget justification is nothing to be wary of. It is simply the logical reasons being a management decision. There are people at all levels in management, including those individuals reporting to you who should be able to justify why they want something or feel they should be allocated certain things related to funding. What is it they want, how much does it cost, when is it required are just a few of the points that should be covered in a budget justification. When these questions are answered adequately and concurred upon, the justification package will be processed. Notice, processed, not necessarily approved. This allows for higher level approval.

In government there are as many, if not more, approval authority signatures required as there are in the private sector. With government budgeting the process begins before June for the following October. How often have the government wheels stopped turning on October 1 because Congress has not yet approved the new budget for the President to sign? This problem doesn't exist because of a lack of justifications but is attributable to the large size of our government structure.

Once the budget is finalized and approved, the manager's hardest job begins. Controlling a budget is difficult. It takes a certain talent to run a large network within the constraints of a budget but it must be done! Another area of concern in this field is the billing function. Many telecommunications people don't want to get involved in "billing" because this area is heavy in people and people related problems. Things like unhappy customers or users and the necessity to balance needs and wants to meet monetary constraints, turn a lot of people off to this area.

The trick to management of a networks's finances is a flexible but adequate cash flow plan. The responsible group or person, must develop a plan to make efficient use of expected funds coming from personal call renumeration, department share billings and other sources. Those sources of funds must be able to meet the expected costs of providing and supporting the network.

When revenue doesn't meet the demand, it puts the responsibility on the network manager to figure what to do next. If there is a prearranged standard or procedure, the manager should refer to those guidelines. If there is none existing, the person or persons responsible must prepare one. Usually the procedure is already in place within some government regulation that the specific affected department or agency is operating in. There are some agencies that do not have this luxury and should plan accordingly.

In the late 1970s, the guidelines the Naval Facilities Engineering Command (NAVFAC) operated their telecommunications under, consisted of a booklet written in 1941! Needless to say, there were more than a few changes to incorporate. In fact, it was appropriate in this case to start from scratch. (See NORTHNAVFACENGCOM INST 2305.1B, 18 July 80 titled "Naval Shore Establishment Telecommunications Facilities and Services Guidance").

MANAGEMENT

The network manager in a government environment is operating in the exact technical arena as those network managers in the private sector. A major difference in the way the two operate, is a lesser autonomy in the public sectors' decision making authority. This one factor, promoted a poorer response time when it comes time for changes. The planning cycle is stretched out by the necessary reviews all the way up through a more complex chain of command. A chain that possesses a self perpetuating lack of experience. This lack of experience is due chiefly, to the built-in turnover rate for military personnel. The head of technical commands is generally a military officer who gets transferred every two years or so. That person is required to be retrained in the skills of each new assignment. This is obviously an effort that takes a substantial amount of time.

Personnel shifts, training, retraining and empathy with superiors are only a few of the challenges the government network manager faces today. These and several other things mentioned below are very similar to those factors faced in the non government arena.

It doesn't matter where the network fits, there are certain networking guidelines that need to be followed. Basic routing decisions that require attention early in the planning cycle include what locations make up the specific community of interest you are planning for. Each location grouping requires a substantial investment in time and tools to complete a traffic study on a decision that must be made on what will happen to overflow traffic on a trunk group and whether or not third party and information type calls can be passed through the network lines.

Another major consideration for network managers today is which interexchange company (IXC) will be able to provide the service on your network. This decision requires the analysis of data to see if options like "time of day switching" should be considered. That is, when you service several time zones it may be cost beneficial to change your routing patterns at different hours of the day to accommodate a heavier flow of traffic. In other words, the corporate busy hour load may ball in one part of the day (e.g. 8am-5pm) in one time Zone while it falls in a different segment of the day in another area. Some IXCs provide better rates for traffic in the time period after 5pm but before Midnight, and even better rates from Midnight to 8am.

A decision on who will carry what part of your traffic must be made well in advance of any procurements to allow the chosen carrier to have enough circuits for your availability on each route, and soon enough for you to verify the proposed quantities of circuits selected.

Once the study information has been completed and verified to a satisfactory conclusion, a routing database is necessary to be inserted into the network switching nodes. If everything is going well the database plan will be complete in enough time to be tested and verified before cutover. It is important to remember, the larger the network being planned for, the longer period of time it will take to complete the design.

REGULATORY

When planning for your network, a lot of consideration must be given to the changing regulatory environment. Telecommunications regulations have been changing rapidly ever since Divestiture.

Traffic routing logic and design is going to be affected in the near future by a change in the way area codes are assigned today. This will affect software presently resident in any switch that interprets routing.

The North American Numbering Plan will be changing in 1995. An expansion that is designed to add 640 more Number Plan Areas (NPA), will begin on June 1 of that year. Currently, almost all of the 152 NPAs available are in use. The new plan is subtle in its design but will confuse most data bases in automatic route selection tables currently in use. Software will have to be modified in virtually all networks, government and civilian. The modifications will be needed to allow dialing of any digit (0-9) for the second digit of an NPA vs today's plan that only allows that slot to be a 0 or a 1.

Regulations are always on the minds of people involved in telecommunications. Ever since the Hush-A-Phone decision of the 1950s, the regulatory effect on this industry exploded. Since Divestiture, there has been absolute chaos interpreting rules of the game.

The FCC began operating in a deregulatory mode in the early 1980s, keeping us all on our toes. Former FCC Chairman, Mark Fowler, started the trend toward deregulation well before he left office in 1988. Even though Congressman Edward Markey, Chairman of the House Subcommittee on Telecommunications and Finance feels the FCC has been too deregulation oriented, things continue to develop in a deregulatory fashion. In April 1989, Patrick Dennis, the then FCC Chairman, authorized a study to see if AT&T should be totally deregulated! There is concern in the telecommunications industry now as to how the FCC will be led, not necessarily by whom.

All of us in this industry must be wary of new regulation freedoms. These changes have a nasty way of altering the way the "game" is played.

TECHNICAL CONCERNS

When considering what architecture to utilize for a specific job, we must look at several things. First considerations should be given to what exists, in place, that may be modified before the network is changed or replaced.

If there is a network already in place, it might be wise to look at restructuring it instead of totally replacing it. This would bring it up to par with your current requirements as well as closer to the current state of the art. This option is also usually the cheaper one open to you.

Technically, all networks are the same. A CCS or an Erland are the same for everyone, with network differences found in the personalities of their management. Designs for network layout, circuit quantities, and numbering plans reflect the style of their management. One manager will engineer for a P.02 Denial (Grade of Service) while someone else might design the same network path so it would accomplish a P.05 Denial rate (e.g. P.02=2%).

When a consultant performs these tasks, they may recommend different numbers of their own selfish reasons. A circuit engineered for a 2% Denial at busy hour will provide a better service quality but will cost more than the 5% option. If cost is a motivator for this particular consultant or manager, which Grade of Service do you think will go in? If you said 5% you were absolutely correct. Attitude or personality can affect routing guide development also. This can happen in any network environment not just government, but the larger the bureaucracy the more likely that personalities get involved.

Government network managers frequently encounter agency bias. When designing a new system, or making a major change to an existing system, one encounters something referred to as "intra-agency politics." Network design tasks take on a new meaning when workers are harassed by personnel from other agencies. GSA manages buildings and facilities for many other agencies. When you deal in this environment, it is imperative that all users be treated equally.

A good example of the GSA type influence is their battle to force their FTS 2000 network on virtually all government users who have their own network, or use the DDD network for long distance calling. Many departments and agencies have used their own proprietary networks for both voice and data over the years. Many of those networks have matured and are being upgraded or replaced with larger and more complex ones.

GSA has been looking at the situation closely and just began to take some actions that will ensure a heavy network population. They froze hundreds of millions of dollars in funds allocated for networks that would duplicate the services FTS 2000 is designed to provide. A major tool they have in exercising this option is withdrawal of their "Delegation of Procurement Authority" that was necessary for these procurements to begin initially.

Several specific networks that have been done away with in this way are three Nuclear Regulatory Commission proposed data nets and a voice network being developed for the US Court System. Another net, one that GSA has reevaluated and allowed to progress is the Department of Interior Data Network. This is a data system for the US Geological Survey that will connect numerous remote locations with an architecture that will allow extremely high data speeds. There are other nets that might be affected by this GSA audit, like those in Housing and Urban Development and the State Department.

It is wise to keep in mind all business has management limitations whether you work in government or non government areas.

TECHNICAL ENVIRONMENT

The three most commonly used network architectures we use today are Tandem Tie Trunk Networks (TTTN), Common Control Switching Arrangements (CCSA) and Enhanced Private Switched Communications Services (EPSCS). They constitute a category of services called Switched Service Networks (SSNs), which are communications network packages designed by major public carriers for large telecom users with substantial private-line requirements. Table 1 presents a comparison of SSN features. To be classified as an SSN, a switch provided by a Local Exchange Carrier (LEC) and Private-line circuits provided by an interexchange carrier (IXC) must be connected with, at least, several PBXs.

Each station user must be capable of establishing a connection with each other station on that network, if so desired by that network management team.

New wrinkles continually develop in this business and one of the newest we should be aware of is the Point of Presence (POP) switching center that has been added to the DDD network hierarchy. Exhibit III diagrams how the POP fits in, which emphasizes why this is important. It is a factor in virtually all network switching because of its location alone.

The TTTN is the forerunner of all network options. It is made up of a complex conglomeration of pieces furnished under various tariffs, usually saving money over public DDD services. It is chiefly designed to add features and capabilities to the network that DDD can't provide. Destination PBSx, as well as switching PBXs, have tie trunk terminations that provide connections to or from an attendant, an individual station or another trunk circuit. Associated private-line facilities can include repeaters and carrier systems in addition to providing both two and four wire transmission paths. Figure 1 depicts a generic TTTN, showing more than one PBX connected by private lines, in a way that allows calls to be switched in tandem through several PBXs.

The second type of SSN commonly encountered is the CCSA. CCSAs have been tariffed offerings for many years, connecting many user locations with two or four wire private lines (Figure 2). Large businesses and governmental agencies use these with dedicated access lines and inter-machine trunks, even though the node switches are sometimes shared with other CCSA customers and telephone company services. Node switches are always housed on the carriers' premises.

A uniform numbering plan for the entire network is one of the most popular features of a CCSA. This includes standard access codes and seven digit numbers for each station on the network. The numbers used for the network are unrelated to DDD central office code assignments. Outpulsing from a CCSA switch is always senderized, meaning the dialed digits are stored by the switch until the trunk is selected and then out pulsed to the receiving node or PBX, without interruption.

If off-network routing is desirable, a CCSA may be the wrong service. Off-network routing is available with the CCSA but only from a select few central office nodes.

The third major SSN architecture, EPSCS, routinely provides off-network calling. Off-net access lines are available from all node switches in groupings of local or long-distance capability. EPSCS is a private line network service designed specifically, by AT&T, to serve large users. It is a totally electronic, highly sophisticated system providing data for cost allocation, facility management and system control, in almost real time. It has the same basic network structure as a CCSA, using dedicated private lines, shared switches, a uniform numbering plan, and station to station dialing (see Figure 3).

Besides the desirable features mentioned, EPSCS provides full-four wire service from customer location to customer location. The primary difference between EPSCS and other networks is its capability of providing customers with their own Network Control Center (CNCC). The CNCC adds a professional air to the network, in addition to the technical and management capabilities it supplies.

The switching node is the heart of any network and offers certain options. CCSAs utilize #5 crossbar or electronic switching system (ESSs) at the nodes; EPSCs use ESSs exclusively, while TTNs utilize virtually any kind of a switch that can tandem a call. Table 1 provides references that list the most common network features desired by both government and corporate users and managers.

The three architectures mentioned above are used for both government and nongovernment networks. Each can contain networks that fall into one of the following seven categories:

1. Single application
2. Organization wide
4. Multiorganization
5. Value added
6. Common carrier
7. International

Single-application networks are the most common type. They are built to serve an individual corporation or government agency with one specific purpose. A good example is the IRS call-in service used during income tax time.

By contrast, a multiple-application with shared circuits and facilities. Government agencies frequently utilize this type of operation and might handle several functions such as accounts payable, accounts receivable, and attendance on one set of facilities.

Organization-wide networks are created by large corporations and government agencies with decentralized computer operations. The networks are designed to interconnect those centers, allowing local and remote access to any of them.

Multiorganization networks are designed to serve groups of similar organizations, like airlines. Travel agents can access flight data from any and all subscribing airlines with a network such as "Sabre," although it is operated by only one airline.

Value-added networks such as Telenet and Tymnet, are developed by communications companies that lease lines from other carriers then charge a fee for other businesses to use them. They add value to basic telecommunications service by providing functions such as error control, protocol conversion, or on-line applications.

A common carrier is tariffed to provide telephone service upon request. It can sell lines to a user or a reseller. AT&T and Bell of Pennsylvania are examples of common carriers.

The last type of network, international, is really the same as the other six types except that it passes across national borders.

MANAGEMENT CHARACTERISTICS

In today's world, the actual day-to-day management requirements fall directly in the Network Managers lap. The network they manage could conceivably consist of a variety of hardware types, various IXC line providers, consultant service providers and even separate billing services. Management in this complex world comes in three distinct types: Active, Passive and Reactive.

The Active manager is one who is deeply involved with all aspects of the program. They are the type of person who helps with traffic studies, follows up on trouble reports and gets their "hands on." This type of person sometimes knows too little about too much. As is said a little knowledge can do more harm than good. If you work for a person of this type, you know exactly what I mean.

However good it feels to have an extra hand, sometimes that extra hand gets in your way.

The other extreme in management is the passive attitude. This person is laid back and assumes a laissez faire attitude (let happen what may). What it actually does is place responsibility down at the worker below level. This could be favorable to both the network and the lower level workers because it allows the responsibility for decision making at the more knowledgeable level. On the other hand, it increases that levels workload.

A combination of the two aforementioned management styles (reactive) is my favorite. I happen to feel more comfortable working for someone who will react when necessary. I have seen many of this style manager in the government arena. Unless I have been working in an unusual string of jobs, this must be the normal governmental modis operandi. This style gives the individual employee greater satisfaction than either of the others.

If you fall into any one of these categories and you feel insecure about doing a good job, ask yourself how many of the managerial traits in Table II you should be working on. If you have a firm handle on each of the points mentioned, you are above the average management person.

The average manager is constantly attempting to increase these skills to better perform the job at hand.

It doesn't matter what type style you have, the skills required to function effectively are the same. The manager has to be capable to make decisions, carry them out and do it in a cost efficient and operationally effective manner. The other items mentioned can be developed or assimilated from an effective association with peers and the other equipment than those you presently have in use.

CHANGING ENVIRONMENTS

The regulatory environment dealt with in networking is as fluid as that in any other area of telecommunications. Ever since Divestiture in 1984, change is vogue. The development that led up to the present regulatory arena are covered well in an earlier report titled "How to Affect Telecommunications Regulation" (Datapro Report MT10-610-101). That report discusses various regulatory bodies and how you can influence them technically. What it doesn't plainly show is the speed with which the current arena is changing.

The telecommunications manager, prior to 1-1-84, trusted and relied on the AT&T System people to help in time of need. These people could be called upon and counted on to provide timely and accurate answers to the questions posed. This no longer is the case, not because the people changed but the game rules changed. "Directory of Telco Order Support organizations" (Datapro Report MT90-500-101) lists the variety of organizations now tasked with this function. Every state has one or more contact points to be dealt with in asking questions or for service of a routine matter!

More than five dozen locations with hundreds of telephone numbers are presented as a replacement for your local Telco representative who, in the past, has all the answers. This problem in itself is worthy of a separate report. Until this issue is addressed and solved in another way, the Network Manager must deal with it.

When the telcom question or problem is unresolved after a reasonable time, we revert to the appropriate regulatory body. The FCC is the source of appeal for interstate services. At the FCC and in the Courts, there is a bifurcation of ideas on how this industry should be progressing. This disparity is serious enough for all decision makers in the field to keep current on developments in both areas. Open Network Architecture (ONA) itself is a serious enough concern to keep abreast of what is happening in Washington. Dennis Patrick, former FCC Chairman said in late March 1988 that ONA is the first priority for FCC study in 1989. Under direction of the FCC, all RBOCS must treat Customer Proprietary Network Information (CPNI) with non discriminatory reporting in ONA environments except for providing credit information to outside companies.

The manager's dilemma is one of balance. They must be a manager of people and things while providing a service to users and doing so in a cost and operationally effective manner.

An efficient manager knows the tools required to perform. He or she knows the tools that should be used, but not necessarily how, and must be able to explain results to upper management.

TOOLS

When you get right down to it, all network managers seek the same things. A mostly automated system that provides alarms, fault isolation and the capability to easily recognize need for and make network reconfigurations. All of the above with the users needs in mind of course.

As we discussed earlier, centralized vs. decentralized management is a personnel policy that is addressed early in the lift of a network. Part of that decision is the use/or exclusive use of in-house staff or outside vendor support. Quite frequently network support and service is performed by outside help because they have certain tools and service you need. This is due to a limited availability of technical expertise in the job market.

Network traffic engineering talent is hard to come by so it is quite common to buy this service from a consultant. It must be taken into consideration however that keeping a job "in House" has certain advantages.

One thing that can't be done very often in house is the development of a display for your network control center. (Figure 4)

Exhibit II is an example of an excellent management tool most effectively utilized in a network control center for tracking of the escalation procedure. An escalation procedure should always be available for use by a manager who wants to have a good "handle" on what is happening under his purview.

The diagram plots each and every decision making point in the installation and maintenance cycle and what to do next.

SUMMARY

This report discusses networking management from fundamental considerations and challenges to the tools that can be used to accomplish goals. It has briefly covered the technical environment and how networks can be implemented. The existing governmental environment is rampant with networks of one size or another, each with its unique set of objectives, features and technological capabilities.

The future looks bright for the networking field. Networks should be trending toward centralization with GSA's lead, the government environment should be no different than the private sector. The bottom line to network management is the network should have as its primary goal, being the most cost and operationally effective tool to meet the needs of your user.

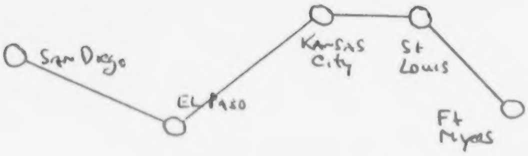

San Diego
El Paso
Kansas City
St Louis
Ft Myers

FIGURE I: A GENERIC TTTN

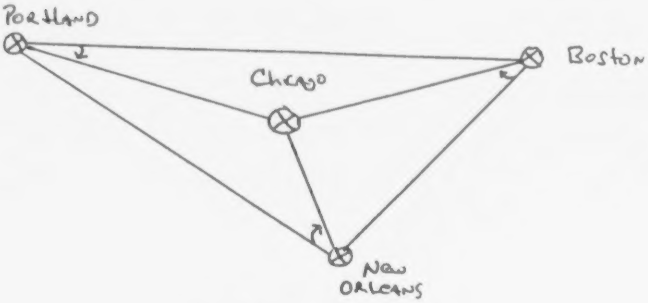

Portland
Boston
Chicago
New Orleans

FIGURE II: A TYPICAL CCSA

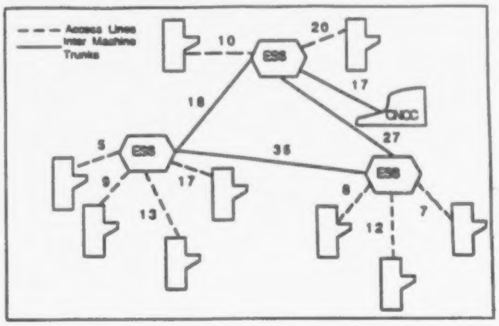

Access Lines
Inter Machine Trunks
10
20
ESS
17
18
CNCC
27
5
ESS
35
9
17
13
ESS
8
12
7

FIGURE III: A TYPICAL EPSCS NETWORK ARRANGEMENT

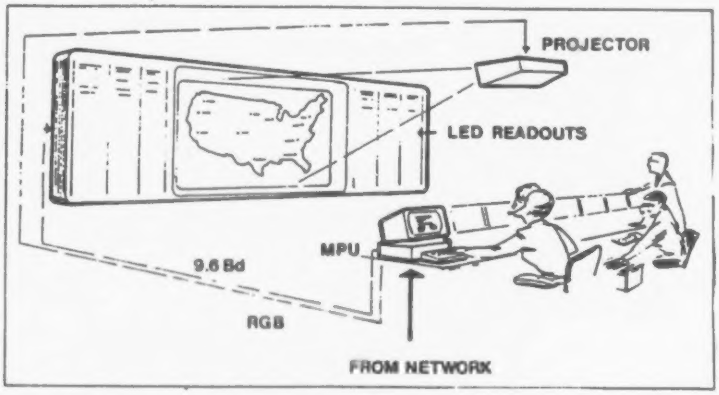

PROJECTOR
LED READOUTS
MPU
9.6 Bd
RGB
FROM NETWORK

FIGURE IV: A TYPICAL SOC (NETWORK CONTROL CENTER) LAYOUT. (Courtesy of George Marsden Design)

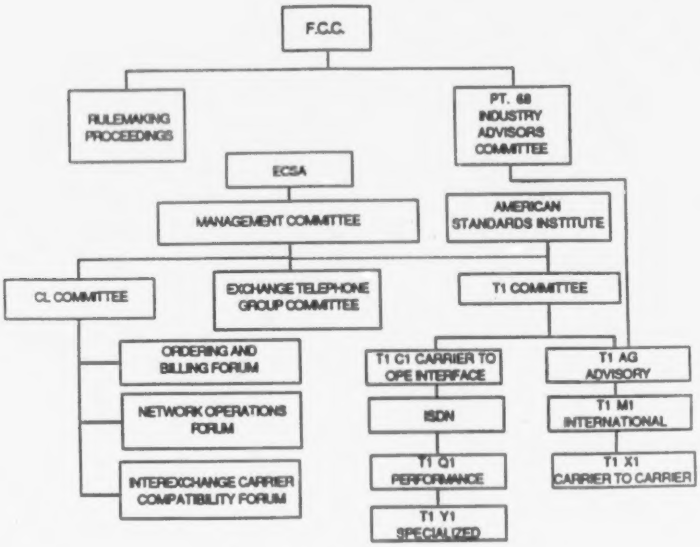

F.C.C.
RULEMAKING PROCEEDINGS
PT. 68 INDUSTRY ADVISORS COMMITTEE
ECSA
MANAGEMENT COMMITTEE
AMERICAN STANDARDS INSTITUTE
CL COMMITTEE
EXCHANGE TELEPHONE GROUP COMMITTEE
T1 COMMITTEE
ORDERING AND BILLING FORUM
NETWORK OPERATIONS FORUM
INTEREXCHANGE CARRIER COMPATIBILITY FORUM
T1 C1 CARRIER TO CPE INTERFACE
ISDN
T1 Q1 PERFORMANCE
T1 Y1 SPECIALIZED
T1 AG ADVISORY
T1 M1 INTERNATIONAL
T1 X1 CARRIER TO CARRIER

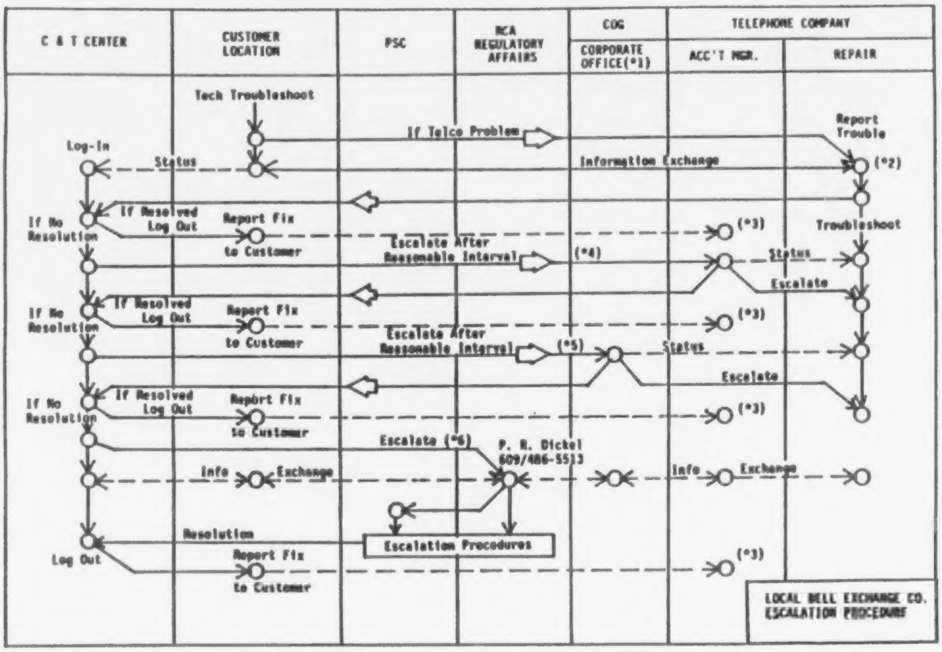
EXHIBIT I. 23 WKGP OF T-1 CTEE

FEATURE	EPSCS	CCSA	FTTN
1. Uniform Dialing	Yes	Yes	No
2. AMA	Yes (100%)	Yes (partial)	No
3. C. O Switching	Yes	Yes	CO or Premises or
4. Electronic Switching	Yes	ESS or XBar	ESS, XBar, or step
5. Automatic Alt Routing	Yes	Yes (Trunks)	No
6. On to Off Net (Auto)	Yes	Yes	Yes
7. Off to On Net (Auto)	Yes	Yes (Attdt Handled)	Yes (Attdt Handled)
8. Automatic/Flexible Route Selection	Yes	Yes	No
9. Network Conferencing	Yes	No	No
10. Wire Switching	Yes	No	No
11. User ID Codes			
a) Authorization	Yes	No	No
b) Accounting Only	Yes	No	Yes (with Dimension)
12. Cust. Net. Ctrl. Ctr/ Admin. Ctr.	Yes	No	No
13. Queuing	Yes	No	No
14. By Pass Routing	Yes	Yes	No
15. Centralized Attendant	Yes	No	No
16. Special Recorded Announcements	Yes	Yes	No
17. Originating Call Screening	Yes	No	No
18. Class of Svc. Restrictions	Yes	Yes (1 Per Cust/Sw)	No

TABLE I. COMPARISON OF FEATURES OF SWITCHED SERVICE NETWORKS (SSN).

- Strong professional skills
- Knowledge of your vendors wares (Equipment)
- Network design capability
- Prospecting for product
- Anticipatory expertise (Prepare for future)
- Substantial professional colleague associations
- Talent for making cost effective operationally effective decisions
- Current knowledge of industry trends in equipment and regulation

TABLE II. MANAGERIAL TRAITS


C & T CENTER
CUSTOMER LOCATION
PSC
RCA REGULATORY AFFAIRS
COG
CORPORATE OFFICE(*1)
TELEPHONE COMPANY
ACC'T MGR.
REPAIR
Tech Troubleshoot
If Telco Problem
Report Trouble
Log-In
Status
Information Exchange
(*2)
If No Resolution
If Resolved Log Out
Report Fix to Customer
(*3)
Troubleshoot
Escalate After Reasonable Interval
(*4)
Status
Escalate
If No Resolution
If Resolved Log Out
Report Fix to Customer
(*3)
Escalate After Reasonable Interval
(*5)
Status
Escalate
If No Resolution
If Resolved Log Out
Report Fix to Customer
(*3)
Escalate (*6)
P. R. Dickel
609/486-5513
Info
Exchange
Info
Exchange
Resolution
Escalation Procedures
Log Out
Report Fix to Customer
(*3)
LOCAL BELL EXCHANGE CO.
ESCALATION PROCEDURE

LEGEND: C&T Center = Maintenance Center
PSC = Public Service Commission
COG = Centralized Operations Group

EXHIBIT II. ESCALATION PROCEDURES

		Reasonable Interval (Working Hours)
*1.	Bell Local Exchange Co. has no COG office. Escalate to Corporate Officer.	
*2.	If not satisfactory, take 1st escalation step.	
*3.	Request Billing adjustment if appropriate	
*4.	Minor trouble No visible response	8
	Major trouble No visible response	2
*5.	Minor trouble No complete resolution	12
	Major trouble Progress in resolving unsatisfactory	4
*6.	Minor trouble No complete resoultion	16
	Major trouble Progress in resolving unsatisfactory	8

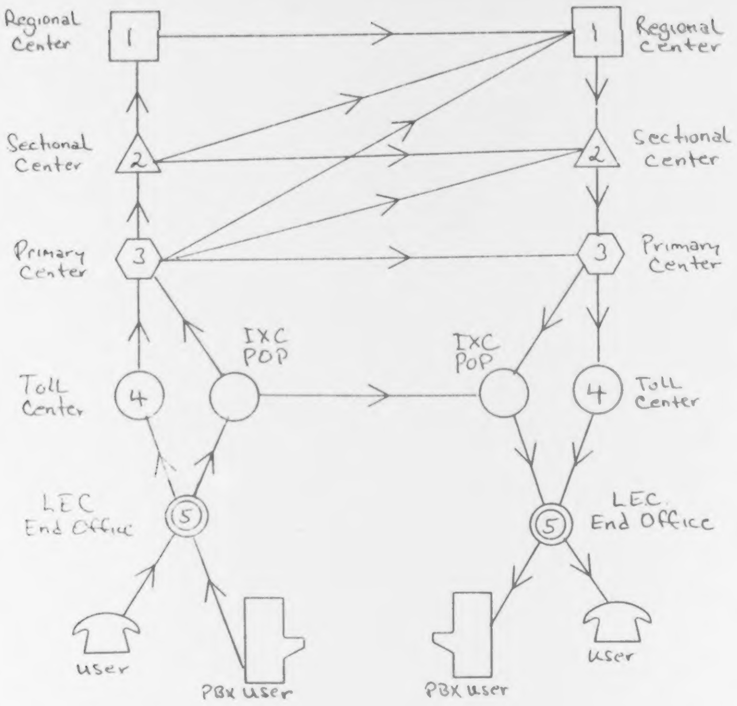

Regional Center
1
Regional Center
1
Sectional Center
2
Sectional Center
2
Primary Center
3
Primary Center
3
IXC POP
IXC POP
Toll Center
4
Toll Center
4
LEC End Office
5
LEC End Office
5
user
PBX user
PBX user
user

EXHIBIT III. NORTH AMERICAN SWITCHING HIERARCHY (POST DIVESTITURE)

CONCURRENT TELEWORK AND TELELEARNING

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Honolulu, Hawaii

Abstract

Several trends move toward concurrent telework and telelearning. Using Hawaii as a reference case, members of this Working Group will compare experiences, identify opportunities and anticipate problems associated with these trends.

1. The current telecom and information network infrastructure, in Hawaii as elsewhere in the Pacific, supports both the decentralization of existing organizations and the formation of new and fully decentralized network organizations.

2. Decentralization projects and programs for both telework and telelearning are underway. For example, the Hawaii Department of Transportation is sponsoring not only a Telework Demonstration Center but related inquiries into home-based telework. The Hawaii Department of Education has introduced distance learning technologies and practices within the existing classroom-based school system. The University of Hawaii has launched the Hawaii Interactive Television System (HITS) with a goal of making individual university courses and degree programs available Statewide. And, of course, Peacesat provides a Pacific-wide "outreach " for the University. The stated goal of these projects and programs is to bring both work and learning opportunities close to where people live and, in so doing, to reduce commuter traffic from workers and students, and to reduce crowding downtown and on-campus.

3. The once sequential pattern of learn-before-working is shifting to the concurrent learn-while-working. Today, for example, many high school students in Hawaii work up to 15 hours per week at fast food outlets and other minimum wage jobs. Some 90% of the full-time University of Hawaii students work between 15 and 40 hours per week. Finally, an increasing percentage of the part-time University students are fully employed adults. At the same time, a growing percentage of "college students" regardless of age are taking longer than the previously expected four years to obtain a BA degree. These non-traditional worker/students now give priority to work and arrange education around the work schedule; most of these busy non-traditional worker/students spend at least the equivalent of a ten hour day per week commuting.

4a. Telework requires telelearning. The decentralization of work into neighborhood telework centers and into suburban homes requires new attitudes, skills and knowledge (ASK) for both employers and employees and for the growing percentage of the self-employed as well. This will be a major education requirement for the current workforce, but probably a minor adjustment for those now studying through telelearning methods. By the year 2010, assuming a steady one percent per year growth rate, some 20 percent of the Hawaii workforce may be teleworkers.

4b. Telelearning prepares for telework. The distance learning programs underway within the classrooms across Hawaii could be configured to prepare the high school graduate immediately to begin telework at a center in the local community. Further, the HITS statewide programs could enable college students to telelearn while engaged in telework, and to do both at a single appropriately designed neighborhood center. The possibility now exists that young people could come of age in Hawaii without ever learning to "commute."

4a+4b. Telework and telelearning share basic characteristics. These include but are not limited to: task-orientation, skills in using screen, keyboard and related technology, self-management, etc. Both require very little travel.

5. The desktop metaphor provides a common vision of telework/telelearning. Downtown workers do paid work at their office desks. Students do unpaid school work at classroom desks. Thus, employed office workers and in-school students both do most of their daily information and knowledge work on the "desktop." Place a workstation on that desktop, connect it into a telecom network, link it to online communication, data base, "open university" and other services. Add the new ASK requirements for a novice teleworker, and the need to use the same desktop workstation--concurrently--for both work and learning becomes compelling. In sum, on the desktop with an advanced workstation, the now separate institutions for commerce and education become a simple mode switch between two windows on the same screen; and, in effect, telework and telelearning become concurrent.

6. Trends toward concurrent telework and telearning:

    6a. What opportunities might they offer?
    6b. What problems might they generate?

Strategies and Tactics for Doing Business in Asia/Pacific

Robert B. Harmon
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Arlington, Virginia, USA

ABSTRACT

For the companies interested in pursuing business opportunities in the Asia/Pacific Region, there are many lessons to be learned. While today's products are very different from those traded hundreds of years ago, many of the factors necessary for success remain the same. Companies can build a business model for Asia/Pacific based on the history of the Region and its time-honored philosophies. This paper presents five principles from The Book of Five Rings and uses these to provide a framework for successfully doing business in Asia/Pacific.

Introduction

Bell Atlantic International has been active in the Asia/Pacific Region for over three years. Initially, Bell Atlantic's strategy was to use a small group of people to become familiar with the environment and to understand the marketplace. Over this relatively short time period, Bell Atlantic has learned a great deal and has enjoyed a number of successes. However, there are many lessons to be learned in the context of the rich history of the Region. In order to be successful in doing business in Asia/Pacific, one needs to draw upon the lessons from thousands of years of trade in the Region.

In ancient times, trade between East and West centered on valuable but relatively simple products such as spices and silk. Today, trade among the international companies in the telecommunications industry focuses on items such as complex switches and software. While the products are different, many of the factors necessary for success remain the same. In a very real way, companies today can build a business model for the Region based on the history of the Region and its time-honored philosophies. One such book that deals with these philosophies is The Book of Five Rings by Miyamoto Musashi. The message of this book, which is the translation of the writings of a great samurai named Musashi, outlines the timeless principles necessary to achieve victory. The following five principles taken from this work can provide the framework for successfully doing business in Asia/Pacific.

1. Understanding the Marketplace

"It [the true path of Heihō, or enlightenment] is that which must be known from the large matters to the small matters, from the shallow matters to the deep matters."

Exploration

As with most new ventures, a small group of "explorers" must set out to chart the territory, in this case the Asia/Pacific telecommunications market. Their primary objective should be to learn and gather information. Their efforts will form the foundation for future decisions relative to the Region.

Formalization

If the results of the exploratory process indicate areas for possible business development, a business plan should be prepared. It is in the formulation of the business plan that corporate goals and objectives are matched to situations and opportunities in the Region. This business plan must have the endorsement of senior management.

Focus

Detailed analysis must be done in evaluating the company's strengths and weaknesses in areas such as products, services and personnel. Corporations should focus in the Asia/Pacific market on the things they know and do best at home. In other words, "stick to your knitting." Voids in expertise can be filled via other resources.

Target

The Region is immense and the telecommunications opportunities numerous. Asia/Pacific contains one-half of the world's population, approximately 1.6 billion people, but only 17 percent of the world's telephones. The Region has some of the most advanced telecommunications structures in the world; in other parts, towns and villages remain without basic telephone service. Governments in Asia/Pacific have earmarked huge portions of their national budgets for infrastructure development.

Playing on strengths, companies need to be selective in their business development efforts. Specific countries and markets should be targeted. Pursue the ones that:

(1) provide opportunities consistent with strengths and
(2) best fit an internally developed criteria list of compatible characteristics for doing business.

A business plan represents the joint efforts of both internal company and external professionals. The findings, conclusions and recommendations should be based on: in-country personnel; marketplace informational data bases; and extensive interviews of managers, executives and industry regulators in selected countries within the Asia/Pacific marketplace.

2. Adapting the Business Plan to the Specific Customer

"Water alters its shape according to the shape of its container, be it square or round, and it can be a drop or an ocean."

Country-Specific Programs

The economies, cultures, demographics and telecommunications infrastructure of the Region are extremely diverse. Consequently, the sales, marketing, business development and post-sales support efforts in the Region will require tailoring to the dramatically differing situations in each country.

Related Issues

Focusing directly on targeted opportunities alone is not adequate. Attention must be given to related issues that affect the ability to conduct business in the Asia/Pacific Region. Examples include, but are not limited to: regulation; privatization; competition; financial (internally and internationally funded); and active participation in trade associations, conferences, etc.

3. Developing Strategic Alliances

"Large things are easy to observe. Small things are difficult to observe. That is to say, it is difficult to actuate one's will with speed with a large number of people; it is difficult to know what is going on with one individual since the spirit of the individual can change very quickly. Matters such as these ought to be carefully considered."

Competition

Competition in the Region has two aspects. In addition to the obvious competition for sales to customers, there is also keen competition for the strategic partnerships that are required for successful market entry. Consequently, companies that are competitors in one situation may be necessary or desirable partners in other situations.

Teaming

Telecommunications business opportunities are very complex matters requiring a variety of skills, expertise and products. Quite often the best approach to such a business situation is one of teaming. Teaming in a particular country can involve a joint venture, partnership, consortium, use of business agents or representatives, etc. Such arrangements also provide the benefit of sharing any risks. Further, local partners can bring the benefit of bridging the enormous cultural gap that exists between Westerners and Asians.

4. Forming Personal Relationships

"Unless one knows well about others, it is not possible to know oneself."

Protocol

Those from outside the Region should remember that behavior traits such as humility are important. They should view themselves as guests invited into the "homes" of their Asia/Pacific hosts. Emphasis should be placed on discussing requirements and areas of mutual cooperation. The visitor must be sensitive to established protocol in the Asia/Pacific countries.

Relationships and Commitment

Business in the Region is based heavily on trust. Trust is built over time and through demonstrated commitment. Asia/Pacific sales lead times can be quite long, sometimes years. Western businesses tend to be short-focused, often not looking much further ahead than the results for the current quarter.

Up front expenses and capital requirements can be considerable. Personnel can become the most expensive aspect of Asia/Pacific business. Expatriate costs are often quite large. Utilization of company personnel, consultants and, very importantly, nationals is critical. Besides the obvious value to the company of assembling the necessary expertise to succeed in the Region, the investment in people, time and capital demonstrates commitment to the customer.

Culture

No one should attempt to conduct business in the Region without first studying its culture. There are many differences in accepted business procedures between the East and the West as well as between the Asia/Pacific countries. Many programs are available to provide cultural training. It is also advisable to hire employees with first-hand experience in targeted countries. Unfortunately, Western businesses often want to rush to the Asia/Pacific market without investing the time to train their people on the Asia/Pacific culture.

5. Updating Business Plans

"When you are truly free within the path of Heihō [enlightenment], an incredible strength surges from within; you react naturally, you become aware of the rhythm of the situation, you face your opponent directly, and take the initiative in attacking."

Continual Monitoring

Beyond the development of a business plan for the Region, ongoing monitoring of activities in business, politics and societies, as well as telecommunications must be done. The Asia/Pacific telecommunications environment is changing and developing rapidly. Existing opportunities have short windows for market entry. A wide variety of new opportunities are constantly surfacing. A regular scan of the Region is essential, with commensurate updating of the business plan.

Conclusion

Conducting business in the Asia/Pacific Region is, by any measure, a major commitment. As such, it should start with a clarification of the corporate mission statement from an international perspective. The placement of Regional operations in the corporate structure and within the corporate goals must be defined. Assumptions regarding the Region and the role to be played by the prospective international company must be identified. Above all, there must be clear support of senior management, including financial commitment.

A complete market analysis must be done, beginning with exploration of the Region and concluding with a detailed business plan. Focusing on selected products based on the combination of in-house expertise and market demand is essential. Consideration must be given to competitors and potential partners. A role, or market niche, can then be defined.

While there are many attractive telecommunications opportunities in the Region, few come without significant challenges and expense. The commitment involved must not be underestimated. Lead times to build relationships can be quite long by Western standards. Travel and expatriates' costs can be considerable, often exceeding projections. Every opportunity should be fully evaluated from both an expense as well as a revenue perspective.

It is advisable to set short and long term objectives. The short term goals will serve as benchmarks to measure progress. The long term goals will demonstrate commitment in the Region and provide an overall framework within which the company would make strategic decisions to ensure the success of its operations.

Above all, the communications flow between the expatiates and the home company is critical. The expatriates must keep top management abreast of the progress of the business development plan. Conversely, the top management must continue to communicate its support for the expatriates.

In summary, the basic principles which guided the samurai to personal successes over 400 years ago continue to be relevant in today's competitive business environment. By applying these principles, the prospective international company can position itself for successes in the Asia/Pacific Region.

Excerpt from The Book of Five Rings by Miyamoto Musashi. Translation © 1982 by Bantam Books, a division of Bantam Doubleday Dell Publishing Group, Inc. Used by permission of publisher.

The Accessibility of International Telecommunications Networks to Business

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ABSTRACT

This paper describes the important role that telecommunications plays in economic development in the Asia-Pacific region and suggests ways to deal with current problems and methods to improve telecommunication infrastructure to promote further development of the region.

Introduction

Trends in economic development, as given in the Figure 1 showing of GDP growth rates, indicate that the focus of world economic activity is moving to Asia and the Pacific. These trends seem to signal the advent of the Pacific Age. Business corporations in this area can consequently be expected to take an increasingly global approach in the future.

What kind of conditions will be required in future to support this economic development? In the field of international telecommunications, which is the bedrock for corporate globalization, both the expansion of infrastructure and the availability of more sophisticated services to cater for the increase in traffic are essential.

Today, I would like to cover general conditions existing in the Asia-Pacific region and examine ways of enhancing the accessibility to the international telecommunications networks to facilitate business communications.

International telecommunications in the Asia-Pacific region today

First, let us compare international telecommunications traffic in the Asia-Pacific region with the traffic in other regions.

Figure 2 shows outgoing international telephone calls for major countries in each of three regions over the ten years from 1979 to 1988. (The comparison covered 17 Asia-Pacific region countries and 11 European countries. In the figure, 1979 equals 100.) You will note that shows, whereas calls have increased 3.2 times for Europe and roughly quadrupled for the United States, they have increased by a factor of 12 in the Asia-Pacific region -- in average a 33% per annum increase for Asia and the Pacific. This alone is enough to show that international telecommunications in this region will grow steadily also in the future.

Figure 3 tells the difference in the growth of outgoing international calls from the Asia-Pacific region to areas within the region and to North America and Europe over the past four years. As the figure shows, traffic is increasing for all three regions, but particularly sharp growth is seen in Asia and the Pacific, where it increased 2.3 times over the four years. Figure 4 gives the percentage of outgoing calls for the same categories. Calls within the Asia-Pacific region represent the largest portion, accounting for over 60%, and are increasing. This illustrates the growing importance of Asia-Pacific region in the world's international telecommunications.

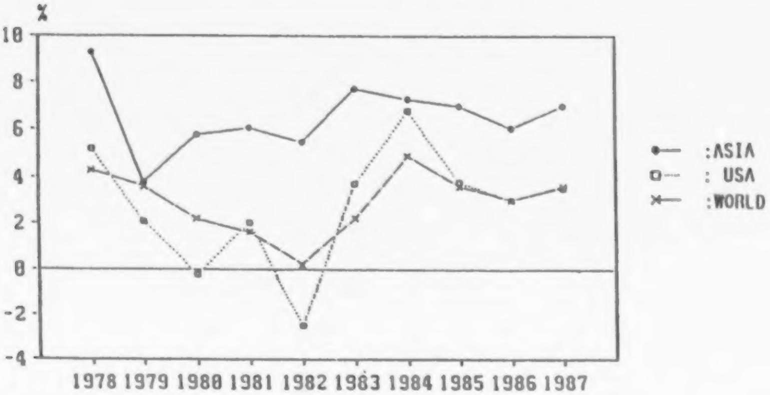
So what is driving all this growth? Figure 5 shows trends in both the number of subscriber lines in four major Asian-Pacific countries and the number of lines connected to PBXs. Compared with a 1.8-fold increase over the ten years for subscriber lines, the number of lines connected to PBXs have increased 3.4 times. Given that most PBXs are installed in the premises of business corporations and are used to increase calling efficiency, a major factor behind the remarkable expansion of these lines is surely the growth of business communications.

The foregoing information tells us that the Asia-Pacific region is at the center of international telecommunications expansion and that this remarkable economic development is spurring the growth of business communications.

Domestic telecommunications networks in the Asia-Pacific region

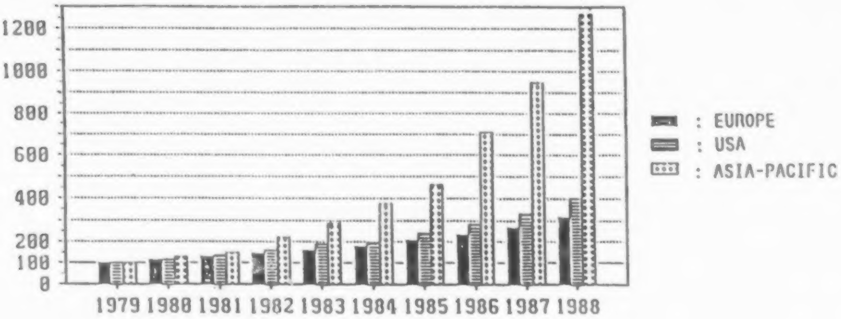
I would now like to look at domestic telecom munications networks in Asian and Pacific countries. Figure 6 shows changes in the number of subscriber lines per 100 population in the three regions in the years from 1985 through 1988. The number of lines in the Asia-Pacific region, although growing a little each year, still pales in terms of absolute numbers before the totals of other regions.

International telecommunications within the Asia Pacific region and between the Asia-Pacific and other regions have tended to rely heavily on INTELSAT satellites and submarine cables. Good quality of service is thus provided for transmission between international gateways, but when we look at the final stage connection from the international gateway office to the subscribers, we find that domestic networks are creating bottlenecks and lowering the overall quality of service. This situation is illustrated by Figure 7, which compares call completion ratios (based on answer bid ratios) in the Asia-Pacific region and the Western Europe region by showing the figures for 20 countries from each of the regions ranked with respect to this ratio from lowest to



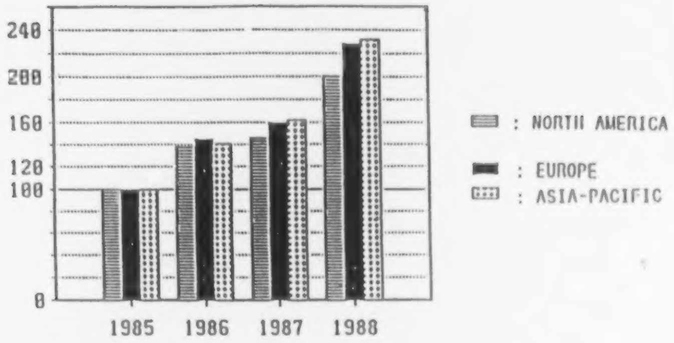
Source: International Financial Statistics (IMF)

Figure 1 Growth rate of GDP



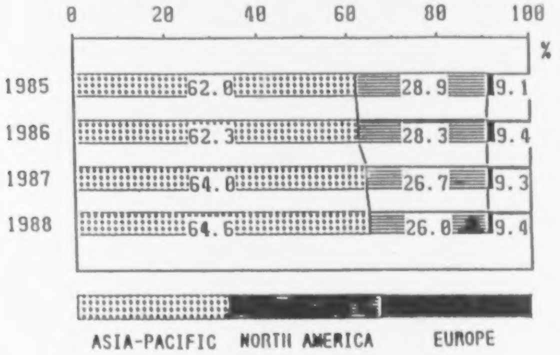
Source: ITU Yearbook of Pubulic Telecommunication Statistics

Figure 2 Number of outgoing international telephone calls
(setting the indicator in 1979 as 100)



Source: The World's Telephones (AT&T Communications Inc.)

Figure 3 Number of outgoing international telephone calls among Asia-Pacific, North America and Europe Regions (setting the indicator in 1985 as 100)



Source: The World's Telephones (AT&T Communications Inc.)

Figure 4 Rate of of outgoing international telephone calls among Asia-Pacific, North America and Europe Regions

highest. As the graph clearly indicates, ratios in the Asia-Pacific region are lower as compared with those in Western Europe.

Solving problems in the domestic networks

There are several approaches to solving this bottleneck problem, that is, to improve the domestic telecommunications network, such as reducing the backlog of applications for subscriber telephone facilities, increasing the capacity of trunk lines, enhancing reliability of the domestic network and introducing new services. Expanding the domestic network requires enormous time and resources and hence this leads to a new thinking on concepts such as "Teleports" and "industrial parks."

The concept of a teleport focuses on creating telecommunications bases around which industry and financial services can then grow. In July last year, joint statement to perform feasibility study on the construction of teleport networks was made in ministerial meeting of APEC (Asia Pacific Economic Cooperation).

Teleport construction plans are currently being pursued in many Asia-Pacific countries. Teleport roles are being studied for a data processing zone (DPZ) in Thailand, Indonesia's Batam Island development scheme, and Malaysia's Labuan Island development scheme. The Japanese Ministry of Posts and Telecommunications is supporting the construction of domestic and international information networks in the region through the establishment of a committee to conduct research into teleport plans, systems concept designs and economic conditions in industrializing countries. KDD is cooperating in this effort as a member of this committee.

"Industrial parks" are another approach, in which industries are concentrated in industrial zones, where telecommunications bases are needed to be established. Many Asia-Pacific countries have turned from agriculturally dominated to industrially dominated economies in recent years, and construction of such industrial parks is increasing.

There is a third possible method, in addition to teleports and industrial parks, for solving the domestic network bottleneck. This is to concentrate on business corporations which are active in international activities but are housed in regions that are geographically restricted to a certain degree. In some cases, their location may be even more restricted; say, to a single building. In such case, it would be relatively easy to provide users with efficient international telecommunications services right from their premises to the satellites rather than going through the congested domestic networks. The Chinese Ministry of Posts and Telecommunications is working with AT&T and KDD to move one such pro ject into practical operation, which I will now describe.

At present, Japan and China Communicate through the INTELSAT satellities and a submarine cable bet ween the two countries; only a few satellite circuits are used for U.S.A.-China telecom munications. In recent years, digital technique has been introduced more and more into the world's satellites and submarine cables to cope with expanding demand for digital telecom munica tions. For China, digital transmission paths are a certainty for the future. The current Japan-China submarine cable is expected to reach capacity sometime in the middle of this decade.

Business corporations in China have long been requesting improvement in the international telecom munications links between China and the world. Now, however, the domestic networks are becoming critical bottlenecks that stifle demands.

In Beijing and Shanghai, foreign corporations are highly concentrated in several building, so they meet conditions allowing them to bypass the domestic network and communicate directly with the international networks. For this reason, the Directorate General of Telecommunications, Ministry of Posts and Telecommunications of the People's Republic of China, AT&T and KDD concluded an agreement on August 13, 1990 to proceed with the following project.

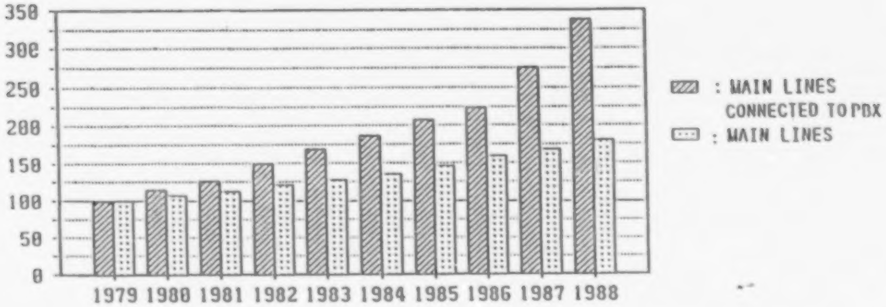
1. An urban gateway earth station for IbS is to be established on top of gateway station buildings in Beijing and Shanghai, and foreign corporations concentrated in several specific buildings are to be connected to that ground station through LDRs (local distribution radiowaves) using digital microwaves. Intelsat satellites over the Pacific Ocean, linking the gateway stations directly with the world, will then provide digital leased circuit service. This project is expected to have the following effects (see Figure 8):

(1) International digital transmission paths can be established quickly using satellites without waiting for submarine optical fiber cables to be constructed.

(2) High-quality digital service can be provided on demand by bypassing both the domestic circuits between the earth station and the gateway station and the local network between the gateway station and the customer building.

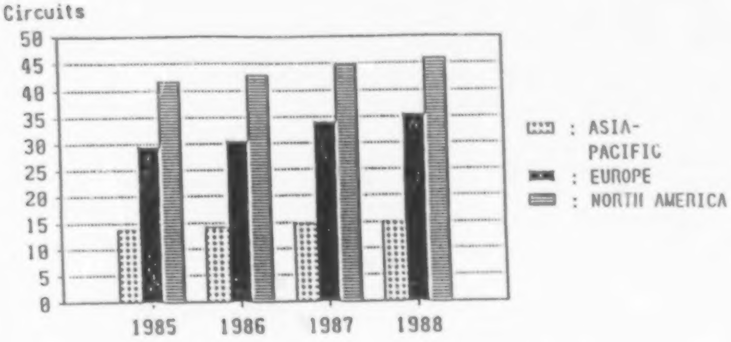
(3) Much of the international traffic currently being handled through local public networks in Beijing and Shanghai can be shifted to this service, thus reducing the burden on the public network and improving the service quality.

2. Parallel to this satellite project, a full fledged digital transmission path is being established: A submarine optical fiber cable is being laid, coming ashore at Shanghai in China and Kyushu in Japan. It is expected to start operation around the end of 1993. By connecting this cable to the APC in Kyushu and the TPC-4 in Chikura, it will become possible to meet all the telecommunications demand between China, Southeast Asia and the United States.



Source: ITU Yearbook of Pubulic Telecommunication Statistics

Figure 5 Number of subscriber's lines and those connected to PBX in the Asia-Pacific Region (setting the indicator in 1979 as 100)



Source: The World's Telephones (AT&T Communications Inc.)

Figure 6 Number of the subscriber's line per population of 100

Figure 7

CALL COMPLETION RATIO
(OUTGOING CALL FROM JAPAN)

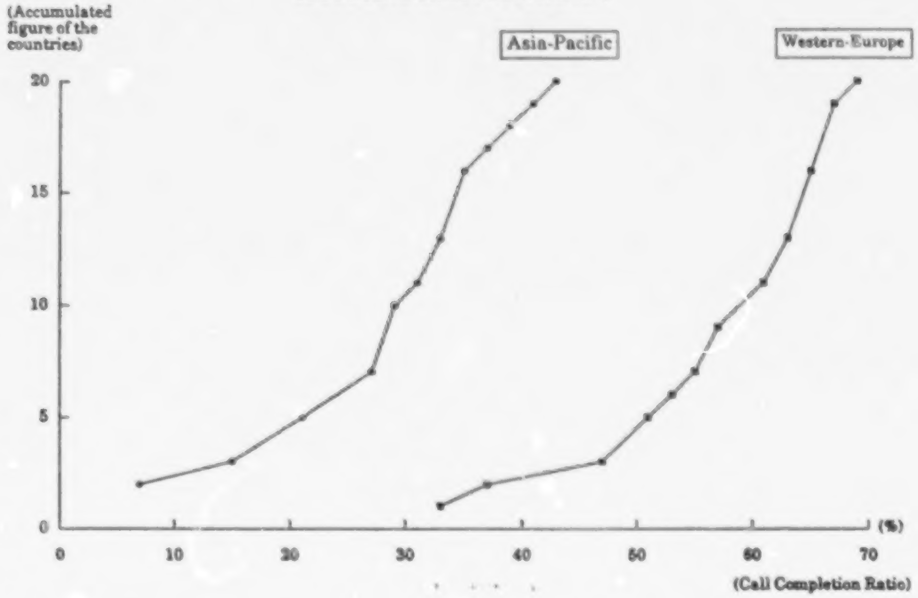
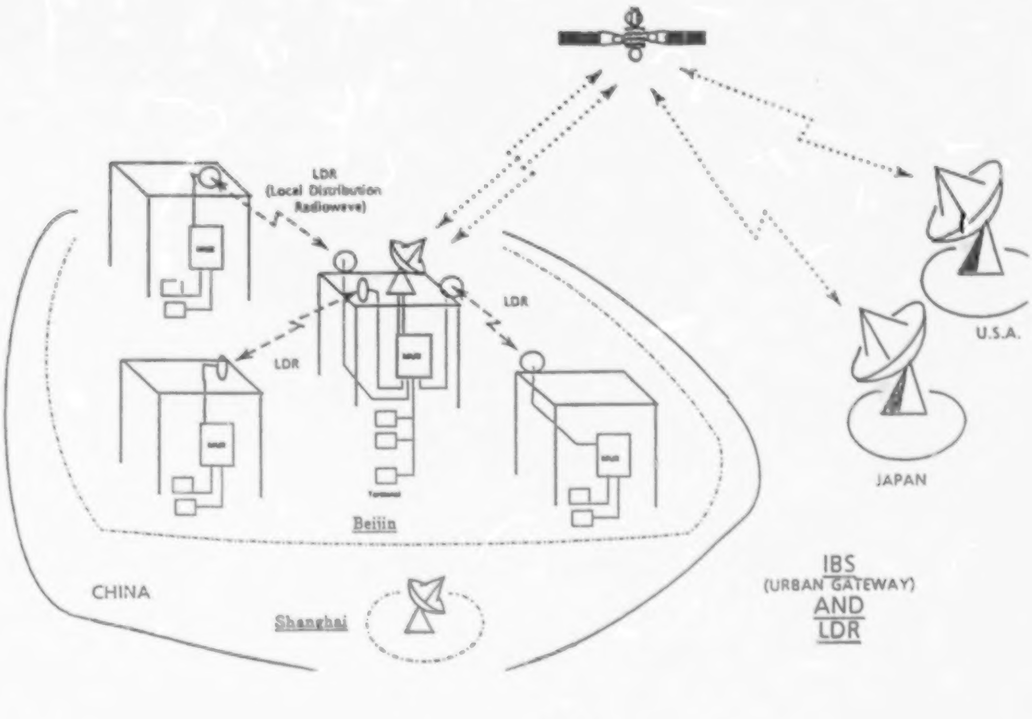


Figure 8


LDR
(Local Distribution Radiowave)
LDR
LDR
Beijin
CHINA
Shanghai
U.S.A.
JAPAN

IBS
(URBAN GATEWAY)
AND
LDR

Conclusion

Globalization of corporate activities is increasing. How well a country can respond to this phenomenon will surely influence its economic development. The capacity of the basic infrastructure to provide efficient telecommunications service will be crucial. Teleports, industrial parks and combinations of LDR with IBS may all be necessary to achieve this goal, depending on local conditions. KDD is determined to cooperate in this effort, contributing its years of experience to the development of inter national telecommunications in the Asia-Pacific region.

Eugene Lotochinski
Vice-President, Marketing
Northern Telecom World Trade
to the PTC '91 Conference
January 15, 1991

Accessing the Global Network: Telecommunications in the 90s

Thank you for the introduction, and for the opportunity to join this panel discussion on such a compelling topic.

I'm sure I won't be the first speaker — or the last speaker — to draw attention to the fact that Hawaii is an appropriate location for a conference on the theme of "accessing the global network."

As this audience will appreciate, Hawaii is an important gateway between North America and the Pacific Rim — it's also the hub for several trans-oceanic fiber transmission networks. And several more of these high-speed networks will be completed over the next few years. The list is extensive — the Northern Pacific Cable (NPC), PACRIM East/West, TPC3, HAW4 and HAW5, and so on.

More importantly, these fiber networks are indicative of a transformation in the telecom industry, and business in general, on a global scale. As part of that transformation — in the past fifteen-to-twenty years — we have seen:

- the rapid globalization of business — companies are reaching out far beyond national borders, increasing their need for more powerful, cost-effective communications systems and networks;

- the commitment by governments around the world to invest in telecommunications as a means to stimulate economic development, and to provide the essential linkages to the world economy;

- and the growth of service- and information-based industries, which is not only supported, but driven by the power of networking.

These structural upheavals are affecting the way we live and work in profound ways. And they provide excellent growth possibilities for global equipment suppliers such as Northern Telecom.

This brings me to why I was invited here today, which is to provide some insight — from a manufacturer's (or supplier's) perspective — on the strategic issues and philosophy of my company's expansion in the Pacific Rim.

It is easy to talk enthusiastically about the Pacific Rim. Any credible industry forecast will tell you that the growth rate for telecommunications equipment, in this region, will be the world's highest over the next decade.

First, let's state the obvious. The Pacific Rim is not a single unified market. It is more accurately described as a geographically dispersed collection of national and regional markets with widely varying business cultures, technical requirements and standards — each with its own specific notions about service and quality, and each with its own approach to competition in telecom services and equipment procurement. All this makes for an exciting challenge — and that's putting it mildly.

But there are some general statements one can make about succeeding in the Pacific Rim. Above all else, you must demonstrate

- a lot of flexibility and patience,
- a keen awareness of the local business culture,
- and a long-term approach to building relationships.

These are the basics. Yet for all the conventional wisdom we hear today about globalization, I believe there is a tendency to underestimate the commitment and resources required to fully appreciate, and deliver, what each market requires.

Establishing collaborative relationships is an essential part of the process. A joint-venture, for example, is often the only way to enter the local market — this is not unique to the Pacific Rim, of course.

To some businesspeople, the concept of "joint-venture" immediately conjures up a vision of being required to invest in a new factory, and to export from such a factory, or to arrange buy-back purchasing, or to provide low-cost or concessional financing. That is true in some cases, but the range of options goes far beyond that.

Entering into a joint-venture is an effective means for absorbing the nuances of the local business culture, and for making the right contacts that will lead to profitable contracts, which is why we're there in the first place.

When we began our marketing efforts in the Pacific Rim about 16 years ago, we worked from an organization that was centralized in North-America. This subsidiary was, in the main, staffed by North Americans who may or may not have had experience doing business abroad.

As we identified opportunities for doing business in the Pacific Rim, it was clear that we had to get closer to the customer. Believe me, you can't build a plant in Malaysia, or start a joint venture in Australia, from an office in downtown Toronto or Washington. You have to be there in body as well as spirit.

Subsequently, a great deal of operating authority was transfered to our smaller regional companies through the 1980s. From Sidney to Hong Kong, we had senior marketing executives and their teams relying on their own initiative to establish our market presence in their regions. In some cases we started joint-ventures, in other cases the structure was decidedly more ad hoc — involving licensing arrangements and so forth. As a matter of course, we began hiring local management talent, and we began to move ahead in bigger strides.

In the past couple of years, it became clear that business activity in the region was multiplying at such a rate as to require a little more control back home. (International sales went from less than 3% of consolidated revenues in 1987 to about 9% in 1989.) Hence the beginnings of Northern Telecom World Trade in 1988 — which is headed by a core group of senior Northern Telecom executives with extensive international experience.

Our main concern now at Northern Telecom World Trade — the organization I work for — is to ensure that our subsidiaries and affiliates in the Pacific Rim region are working toward common goals. Aside from troubleshooting in each region on occasion, we are concerned with longer-term strategy — such as staffing our operating units properly during this growth phase.

This isn't as easy as you think, for example, when you need 100 sales people who speak Mandarin Chinese and are knowledgeable about your product line. Or when you have to take an 18-hour flight, and then endure a long train ride, just to attend a board meeting of your Chinese joint-venture in Guangdong Province.

Northern Telecom started its activities in the region by establishing offices in Singapore and Hong Kong, and a little later on in South Korea. In recent years, we have sharply increased these efforts. We now have sales and marketing offices in Tokyo, Taipei, Beijing, Sidney, and Melbourne. In total, we employ about 500 people in our marketing and sales offices — and another 2500 people employed at three manufacturing plants in Penang, Malaysia.

We have frequently worked through local distributors in order to take advantage of existing sales channels and market knowledge. We do this in Japan, Hong Kong, Singapore (to name three) — which are dynamic markets in a rapid state of transition, and which are, in their own right, world leaders in telecommunications. You need as much local expertise as you can find to succeed in these markets.

We build our own factories (Malaysia) — or we build them with local partners, as we did in China and Australia. In certain countries we are required to licence our products to one of the major manufacturers in the country, and we have done this in North Korea and South Korea.

All in all, we are not afraid to cooperate with local companies, or to draw on local expertise and resources. Let me add that, in all the countries where we operate, we recognize their need to develop and maintain what is called — for lack of a better term — technological sovereignty, while at the same time pursuing our objective of achieving market penetration in a meaningful way.

Our strategies in the Pacific Rim, however, are best illustrated on a market-by-market basis.

Japan is a major strategic market for us — for the simple reason that it is one of the largest telecommunications markets outside North America. But the Japanese market is already served by four quality Japanese suppliers. It is also in a state of rapid transition (20-30 percent cuts in international long-distance rates, with 39 Type I and over 600 Type 2 carriers emerging since NTT's privatization).

There has been a lot of talk about the Japanese market being closed. Our experience is that it is not closed. Indeed it is easier to try to do business in Japan than in many other countries. It is succeeding which is difficult. This is a very demanding market with customers who know precisely what they want, how they want it, and who are used to very high standards of quality and service.

When we first entered the Japanese market in 1982, we felt it was important to learn as much as possible about NTT's network. And what we learned was largely achieved through the efforts of a small group of expatriate senior executives from North America. This, as I mentioned earlier, was our initial approach in scouting out the market potential.

By the time NTT was privatized in 1988, we had enlarged our staff to include many Japanese nationals and won one of the largest contracts ever granted to an outside firm by NTT. The contract — for our DMS-10 rural central-office switches — will be worth well over US $250 million when it is completed in 1993. We also sold one of of our gateway exchanges to IDC about a year ago. And we are now making good progress in the PBX market through our local distributor.

In Japan, of course, you have to learn to work within the system, given the complexities of the distribution network. It is also advisable to *be marketing* a product which is not being offered locally. We succeeded with the DMS-10 and gateway exchange because our products were unique in their categories. And because we were willing to go to great lengths to provide the service support and make the software modifications to meet our customer's expectations.

In terms of building a long-term business in Japan, it is not essential to establish a local manufacturing operation, or even to licence a Japanese manufacturer. Our biggest challenge is people-related — such as developing the management skills of our senior Japanese employees. We employ about 50 people there today who are mostly Japanese nationals. They work closely with our major customers, such as NTT and IDC, and with our local distributor.

The point I'm trying to make is that a truly global company is essentially a distributed structure. You cannot, over the long run, expect to export management and technical expertise into a market such as Japan. You have to invest in local talent — in Japanese research scientists, network engineers, sales and marketing staff, accountants — right up to the level of company president. And you have to devise programs to make these people an integral part of your company. That means being able to absorb new influences within the global corporate culture, and to transfer real operating authority to the region. That too is a process with its challenges.

The problem I see is related to time and experience. In North America, some of our senior executives have more than 25 years experience with Northern Telecom. It's obviously going to take some years before we get that kind of experience from within the ranks of our Japanese subsidiary. Over time we will, and it is exciting to think where that will lead us.

The People's Republic of China is also a strategic market with enormous potential. The Chinese government, while it changes the direction and the rules of competition, is keeping the market open to outside suppliers. The Chinese are conscious of the need to conserve foreign exchange, which they dole out very carefully for purchases that have been scrutinized by several authorities before being approved.

For any significant type of product, the Chinese insist that suppliers form a joint-venture with a local supplier. Once a joint-venture is formed, no more products of this type are allowed to be imported.

We have been working in China since 1984, a little more than six years. And, again, we have made good progress — with contracts totalling more than 400,000 lines of digital switching. We have also made strides in the PBX market, with over 100,000 lines sold. In 1988 we signed a joint venture to manufacture that product in China.

The challenges in China, for an outside supplier such as Northern Telecom, are considerable. Not too long ago, there were only a small number of entities engaged in foreign trade in China. They served as trade windows to the world. Now, there are literally thousands of customers, factories, import-export companies and specialized organizations dealing in trade and investment matters.

Except for strategic or very large projects, you may be dealing with various end-users at the provincial or municipal level, or a trading corporation, or a trust or investment company — or all of them at once. With all these market sectors opening up, you need to focus on the best available opportunities to succeed. Competitive pricing and prompt service are essential — as is flexible financing and government support back home, given the foreign exchange situation.

I would like to add that we were honored to provide the telecommunications equipment for the Eleventh Asian Games held in October in Beijing. Our equipment formed the hub for the voice and data communications that connected the 17 sites where the various events were held.

Turning now to the Australian market, our entry there was made more difficult through high tariff barriers. To get around this, in 1987 we established a joint venture there with a local partner, which involved manufacturing our Meridian SL-1 PBX. By starting a new company with strong local representation, we were able to quickly penetrate the PBX market, and, in addition, to win a key contract for a gateway exchange for the international carrier in Australia (Telecom Australia).

We also attribute our success there to the size and market conditions (huge distances, sparsely populated) in Australia, which are suited to our products and aspirations. Based on our initial successes, we purchased our Australian partner's share of the joint venture to consolidate our market presence. And we established an R&D lab in Australia to complement our manufacturing operations.

Although, the size of our Australian subsidiary in no way compares with our North Americas subsidiaries, it maintains the structure of a fully-integrated company — or expressed in corporate jargon, we have created a regional "center of excellence" which is entirely self-sufficient from an operations and marketing standpoint.

The challenge here, again, is to ensure that our Australian employees are given enough freedom to conduct business on their own terms, while at the same time contributing to their career development as a members of the Northern Telecom family.

I look forward to exploring, with my panel colleagues, some of the human resource issues in managing a global corporation — which ranks at the top of our priorities at Northern Telecom.

An interesting sidenote: We are now finding, ironically, that the advantages of local manufacturing are not as apparent as they used to be — for us, or for our partners. The reason is because of the shrinking labor content in our equipment. It is getting much harder for a smaller-scale joint-venture operation to produce, at a competitive cost, small quantities of equipment. Today, we are seeing more and more licensees becoming distributors of our products, instead of licensed manufacturers.

The result is that our licensees are increasing their sales of our products — now purchased, instead of licensed — and increasing their profits on those products, and they're branching out into new products at the same time. Our relationships with our global partners are, in fact, becoming stronger, and their access to our technology and R&D expertise continues unabated.

On the subject of partnerships, you may be aware also that, Northern Telecom recently acquired a global partner, the leading U.K.-based telecommunications supplier, STC plc., in which it previously held a minority position. This acquisition reflects the importance we place on globalization as our long-term business strategy. STC is one of the world's leading leading suppliers of fiber submarine cable, with extensive contracts in the Pacific Rim — and the company has other strengths and relationships that will complement Northern Telecom's in the region.

There are two final points I would like to address concerning the potential of the Pacific Rim telecom markets.

The first is that the growing competition in the region can only stimulate innovation — and this is encouraging from our point of view. It is an accelerated pace of innovation, in particular, that will be required, in the 1990s to build on the world-class networks that already exist in many areas of the Pacific Rim, and to enable a coherent upgrading of the basic networks operating in other areas.

We all realize that there are contentious issues in the debate over allowing greater competition among equipment suppliers, or in re-regulating long-distance services, or in the privatization of telephone operating companies. The debates are intense and protracted, and that applies in virtually everywhere in the world — in North America, Europe, Latin and Central America, and the Pacific Rim region as well.
But the advent of greater competition will — in any market — bring about a faster and more effective introduction of new services and technologies into the network. The benefits of these new services will flow to all sectors of society. And this is the reason, ultimately, for building networks that are responsive to local needs and yet have global reach.

The second point is that any trend toward more competition, or re-regulation, or liberalization, should lead to wider acceptance of open technical standards as the basis for the network architecture of the 90s. As new telecom services become global in reach, the issues of standardization and compatibility between systems and networks will become increasingly important.

Network planners in the 90s will have to adapt to the potential of ISDN, broadband switching, Signaling System Number Seven, SONET, Frame Relay, Asynchronous Transfer Mode — and wireless technology, including digital cellular.

It's clear that setting uniform standards — applicable wherever a company does business in the world — will be a vital part of the process in creating the intelligent information networks of the twenty-first century.

And there are positive developments happening in this area. For example, the base level standards for the Synchronous Optical Network, or SONET, have been finalized. And global standards for wireless and personal communications networks are under review by international standards organizations — all in an effort to make the broadband, personal network of the future as easy to use as today's telephone.

Similarly, the distinctions are blurring between local-area-networks and wide-area-networks. Here, too, standards are finally in place to support communications among customer-premises equipment (CPE), between CPE and data equipment, and between CPE and computers.

And there's also progress being made in setting frame relay and OSI standards — especially the X.400, and the CCITT H.261 video standards, which eliminate barriers imposed by proprietary architectures.
In the past, public and private telecommunications networks have been optimized for narrowband communications, primarily voice. But this is not good

enough any more. We can't afford to manage an overabundance of dedicated private networks, each with much less than critical mass.

As a manufacturer, Northern Telecom has decided that we must develop a network architecture that supports many applications — a single network architecture for all services, not a different overlay for each unique application.

In closing, the future looks very promising in the Pacific Rim for global equipment manufacturers that are willing to:

- apply patience,
- be flexible in their business methods,
- be able to offer financing arrangements,
- be prepared to provide local service and support,
- and have the resources to support a prolonged marketing effort.

These are exciting times in our industry — no matter which area of the business we put under a microscope. Who would have thought that — after 120 years of stable existence -- the telecommunications industry would be in the dynamic state of transition as it is today?

Thank you for your time, and I look forward to any questions you may have.

MARKET ENTRY STRATEGIES IN THE WESTERN PACIFIC RIM

by Stuart M. Hauser
J. Michael Laughlin
SRI International

Countries of the Western Pacific Rim are poised for substantial economic growth in the 1990s. Telecommunications markets are gearing up for suppliers of telecommunicatons systems and services. The window of opportunity may be open for no more than three to five years at the outside and significantly less in many of the country markets. A key factor for commercial success in these markets is recognizing that entry strategies must be tailored to suit the unique economic and technological characteristics of each country and yet fit within a regional context.

STUDY SCOPE

SRI has recently completed an assessment of the telecommunications infrastructures and markets in thirteen countries of the Pacific Rim. These countries (Figure 1), often referred to as the Asia-Pacific Region, include New Zealand, Australia, Indonesia, Brunei, Singapore, Malaysia, Thailand, the Phillipines, Hong Kong, Taiwan, the Peoples Republic of China (PRC), South Korea, and Japan. They differ strikingly in terms of population, business and cultural practices, national economies, relative industrial development, technological sophistication, and telecommunications infrastructure. Overall, however, the Asia-Pacific Region can be characterized as a major market opportunity for providers of telecommunication services and products. While each country demands a different entry strategy from the potential telecommunications investor, common principles can guide a telecommunications market entry strategy for all countries in the region. This report presents a brief overview of the region in terms of population, economic development, and telecommunications infrastructure and markets, and discusses some of the principles that we believe should guide multinational companies seeking to do business here. (Of course, significant disturbances in the world's political and economic environment can affect the findings presented in this assessment.)

Asia-Pacific Population

The thirteen countries studied support a population of 1.7 billion people (Figure 2), 30% of the world's total. In terms of population, the Peoples Republic of China (PRC) dominates with more than a billion people, over three times the population of either North America or the European Community. Japan and Indonesia each have over 100 million people; in fact, Indonesia has the fifth largest population in the world, with over 180 million. The other countries have populations ranging from 250,000 in Brunei to 62 million in the Philippines.

Asia-Pacific GDP

The region has a Gross Domestic Product (GDP) of $US4.6 trillion (Figure 3). Japan, an economic superpower by any standard, contributes the lion's share of the region's production with a GDP of $US3 trillion. It is followed by the PRC, with a GDP of $460 billion. Australia, South Korea, and Taiwan complete the top five GDP positions, with GDPs from $174 to $184 billion. The remaining eight countries each produce less than $100 billion, ranging from Indonesia at $US96 billion to Brunei at just under $US4 billion.

Relative Regional Economic Development

GDP per capita provides a more accurate measure of national prosperity and a more revealing picture of economic stratification within the region. Japan sits at the top of the pyramid with a GDP per capita of $US24,000, higher than those of either North America or the European Community. Australia and the tiny oil sultanate of Brunei constitute the second tier, with GDP per capita of $US15,000 to $US17,000, on a par with countries of the European Community. The broad middle tier includes New Zealand and the Newly Industrialized Economies (NIEs) of Hong Kong, Singapore, Taiwan, and South Korea, which have GDP per capita ranging from $US5,600 to $US12,000. The bottom tier of countries includes Thailand and Malaysia (both intent on achieving NIE status) with GDP per capita of $US1,100 and $US2,300 respectively, and Indonesia, the PRC, and the Philippines, each with GDP per capita of less than $US800.

Economic Growth in the Region

Most exciting to the multinational corporation are the impressive growth rates of the Asia-Pacific economies. Per capita GDP is expected to grow an energetic 49% between 1990 and 1995 in the region as a whole, with even faster growth anticipated in individual countries such as Japan, the NIE's, and Thailand (where growth has exceeded 10% per year). This growth rate is significantly above the 35% growth expected in North America over the next five years.

Regional Telecommunications Infrastructure

The various telecommunications infrastructures in the region also reflect the disparity in economic development among the Asia-Pacific countries. On a regional basis, the availability of telecommunication capacity is rudimentary: there are only 6 access lines per 100 people in the region compared with 52 per 100 in North America and 37 per 100 in the European Community (Figure 4). Differences between countries within the region are striking. The more developed economies have 20-45 access lines per 100 people, generally on a par with or better than those achieved in the European Community. In the less developed countries, however, the availability of access lines is very limited, on the order of 0.5-8 lines per 100 people. The difficulty of increasing number of access lines in many of these countries is further compounded by the relatively few urban concentrations of population and their geographical terrain. Indonesia, the Philippines, and Malaysia, for example, are all island nations with very dispersed populations.

Telecommunications Capacity Growth

The growth in telecommunications capacity is expected to be quite strong during the 1990s. As a whole, the Asia-Pacific region is adding access lines per capita at a 6% rate, twice the rate in North America. Each country in the region is adding capacity at a rate of 4% or more but some countries, including the PRC, Thailand, Malaysia, and Indonesia, are adding capacity at significantly higher rates, in the range of 10-17%. South Korea alone will add over one million access lines in 1991.

Role of Telecommunications in Regional Growth

The rapid growth in regional telecommunications capacity demonstrates the important role played by modern telecommunications infrastructures in the economic development plans of individual national economies. A modern telecommunications infrastructure is clearly seen as a prerequisite for supporting growth in other sectors of the economy and as a fundamental requirement for attracting foreign investment.

The telecommunications sector is also generally viewed as a vehicle for meeting other important national goals, serving as a mechanism for importing advanced technology, educating and training a modern workforce, and, ultimately, developing the capability to compete internationally in high-technology markets through export of advanced products and services. Telecommunications is also a source of income for many governments, for improvements in telecommunications capacity and service can lead directly to increased government revenue, which may be a significant source of foreign currency in a developing economy.

Telecommunications Expenditures and Market Size

As noted above, the quality of telecommunications service has become a vital component for improving the competitive position of Asia-Pacific countries in the international economy. Consequently, it is not surprising that regional telecommunications construction budgets form a larger portion of the regional economy than is true in the United States. The Asia-Pacific telecommunications construction budget, estimated at $US21.8 billion in 1990 as compared to $US24.1 billion in the United States (Table 1), constitutes a much larger portion of Asia-Pacific economies even through the budget is itself smaller. Total spending on telecommunications products and services in the Asia-Pacific region is estimated at $US113 billion in 1990 and is expected to increase to $US178 billion by 1995, representing a regional compound growth rate of nearly 10%.

Table 1
CONSTRUCTION BUDGET (1990)

- Regional construction budgets*

United States	$24.1B
Asia/Pacific	$21.8B

- Total spending on telecommunications in Asia/Pacific region

	1990	1995	CAGR
Services	$86.8 billion	$138.7 billion	9.9%
Equipment+	$25.8 billion	$ 39.1 billion	8.7%
Total	$112.6 billion	$177.8 billion	9.6%

*Current construction budgets for Canada and the European Community are not available

+Purchases of telecommunications equipment by the country's telecommunications authorities (PTTs) and Customer Premises Equipment (CPE) by users; excludes computers and peripheral equipment

Market Opportunities

Some unique opportunities for vendors of telecommunications products and services have become available as a result of the emphasis placed on expanding and modernizing telecommunications facilities in the region. These opportunities are further enhanced by the current trends toward privatization and deregulation and the general opening of Asia-Pacific economies to foreign investment. In general, as countries focus increasingly on developing modern telecommunications networks and services, they also increasingly look to international corporations for participation and investment. Opportunities range from the traditional (i.e., importing telecommunications and computing hardware) to the sophisticated, including revenue sharing opportunities such as those Thailand is using to modernize and expand its telecommunications network. During the past two years alone, a variety of opportunities has emerged for foreign owned telecommunications companies to participate in the Asia-Pacific Region: all or a portion of the equity of many publicly owned carriers has become available, franchises are offered in wireless communications and other services, participation is being offered in proposed new satellites, the region is becoming criss-crossed with fiber-optic submarine cables, domestic communications networks are being upgraded with state-of-the-art equipment and operating software, and new markets are appearing in value-added services.

There is, however, a finite window for exploring and taking advantage of these market developments. Only a limited number of equity investment opportunities are or will become available, and competition for them and other business opportunities is already intense. The battle for long-term market position in the region is well underway.

Market Competition

Telecommunications companies from North America, Western Europe, and the Asia-Pacific Region itself are all vigorously pursuing market opportunities in the region. They are partly driven by increasing competition and decreasing growth rates in their respective domestic markets but also by the perception that to succeed in the long run, world players in telecommunications must compete in at least two of the three major world markets, N. America, W. Europe, and Asia-Pacific. It is not surprising, therefore, that companies such as AT&T, British Telecom, Cable & Wireless, NTT, KDD, Siemens, IBM, NEC, and all seven of the U.S.'s Regional Bell Holding Companies are active in the Asia-Pacific Region.

Local and regional competitors are also pursuing these markets aggressively. In particular, the two major Japanese telecommunication firms (NTT and KDD) and Japanese communications equipment suppliers already constitute a major regional force as de facto banker and source of development aid funds in the region. Korean, Australian, and Taiwanese companies are also strong regional players. Within individual countries, local players may hold very strong positions, often with the support of their respective governments. As a result of this competitive activity, it is generally accepted that the window of opportunity for capturing market share is three to five years at the outside but that in some markets it may be significantly less.

Market Entry Strategies

Entry strategies need to be adapted to the environment of each country. Intra-regional issues (e.g., Hong Kong versus Taiwan as a door into the PRC; Thailand as a base for operations in Indo-China) can also be important when shaping a market strategy. There are, however, several common principles that successful competitors will observe.

Commitment to the long-term is a critical element of a market entry strategy in the Asia-Pacific Region. Companies should be prepared to maintain a strong country and regional presence for at least 3-5 years. Corporate and personal relationship building is a very important part of Asia-Pacific business cultures and business decisions are often made on the basis of personal relationships between corporate executives and leaders in the business and government communities. This factor also has implications for executive staffing strategy; for example, executives should commit to these projects for their duration to facilitate forming the kinds of personal relationship that will promote success. This should be particularly heeded by American companies that appear to use overseas assignments more as an executive training ground than as bonafide long-term career assignments.

Corporate positioning is also a critical element of a market entry strategy. There is a great demand throughout the region for skills training and jobs, technology transfer, and project financing. The more a company can position itself as adding value in these areas, the more attractive it will appear as a potential partner or contractor. The location of plant, laboratory, and regional headquarters facilities can be an important part of corporate positioning. Demonstrations of good faith through work-study programs, exchange programs for engineers, and corporate donations of equipment to universities and polytechnics can also go a long way toward establishing credibility with key decision makers. A common denominator in the region is the increasing demand for the transfer of state of the art technology. Companies must be prepared for tough negotiations on this issue and for dealing directly with the cynicism they will inevitably encounter, which is a residue of the unfulfilled expectations from previous technology transfer agreements.

The business form for market entry (e.g., subsidiary, joint venture, agent) will vary from situation to situation and country to country, but generally some sort of corporate or "strategic" alliance will be involved. In large projects, partnerships or cooperative ventures are the rule rather than the exception owing to the size of required funding commitments and the need to spread risk and share expertise. Participation of local companies is often required by government mandate, so companies should be prepared to partner with firms that could be competitors in other situations. Such arrangements are usually deal-specific, although in some cases they may have regional or even international implications.

CONCLUSION

The Asia-Pacific region is an important area for growth in the 1990s, and telecommunications will play a key role in the region's expansion. The changes in technology, investment, regulation, and ownership that are sweeping the region are creating a unique period of opportunity for providers of telecommunications services and products. Competition for these opportunities, however, is intense, and the window of opportunity will not remain open long.

Companies must have a coherent, thoughtful strategy for the Asia-Pacific Region. Above all, success will require the development and implementation of a strategy that incorporates first-hand executive knowledge of the region as well as observing the various long-term commitments that may be required. This level of involvement will be needed to counteract the frequent false starts that have characterized the many highly visible entries of off-shore multinational corporations.

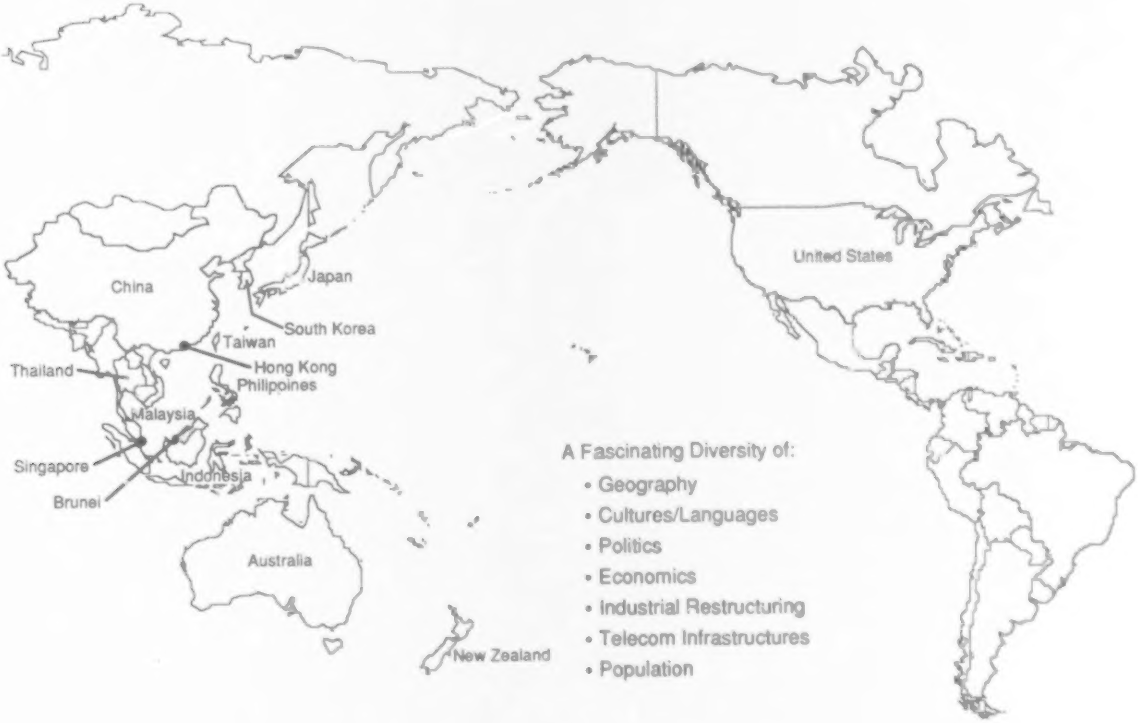
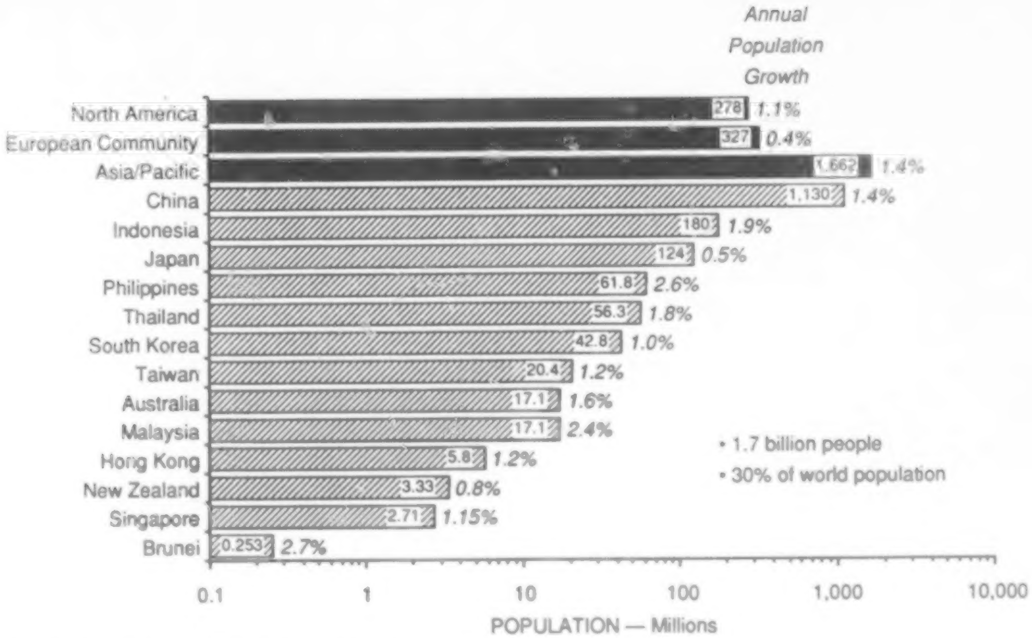

Japan
China
South Korea
Taiwan
Hong Kong
Thailand
Philippines
Malaysia
Singapore
Indonesia
Brunei
Australia
New Zealand
United States
A Fascinating Diversity of:
• Geography
• Cultures/Languages
• Politics
• Economics
• Industrial Restructuring
• Telecom Infrastructures
• Population

FIGURE 1 THE ASIA/PACIFIC REGION

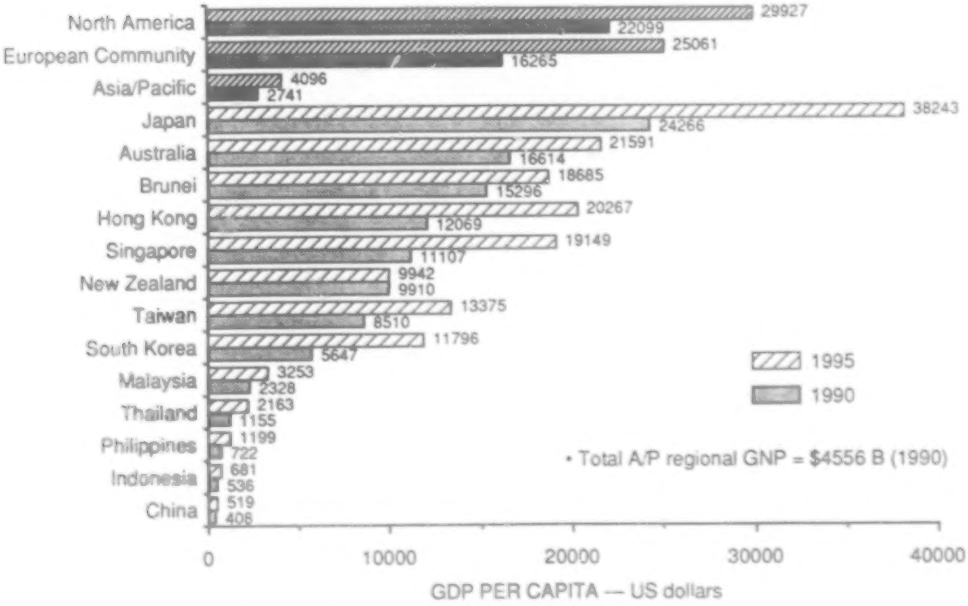


• 1.7 billion people

• 30% of world population

SOURCE: Business International Forecasting Services

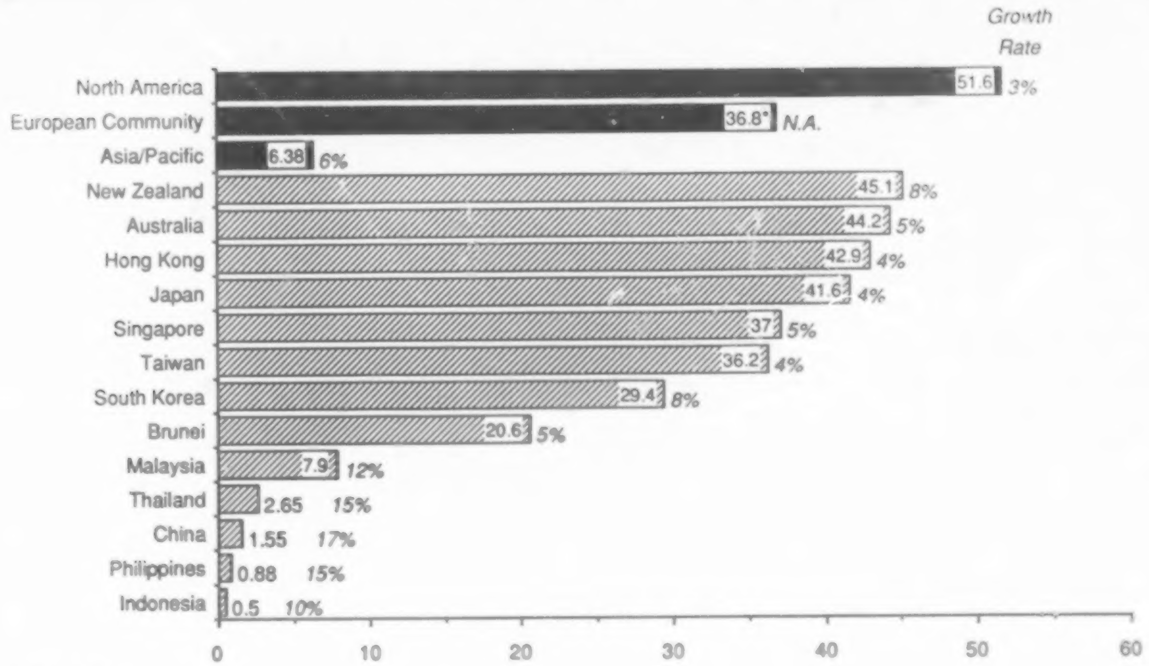
FIGURE 2 1990 POPULATION



• Total A/P regional GNP = $4556 B (1990)

SOURCES: SRI International; Business International Forecasting Services

FIGURE 3 ECONOMICS — GNP PER CAPITA



° 1967 data

N.A. = Not Available

SOURCE: SRI International

FIGURE 4 1990 ACCESS LINES PER 100 POPULATION

Wednesday, January 16, 1991

Morning Plenary

NOTES

Telecommunications Trade in the Pacific
A Canadian Perspective

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ABSTRACT

Canada is a nation with a long history of trading with the rest of the world. Our natural resources have traditionally been the basis of such trade. However, our export economy is increasingly diversified as evidenced by the success of Canadian high technology firms in some of the world's toughest markets. The paper will address the topics affecting telecommunications development and trade within the Pacific region.

It is indeed a pleasure to be with you today and to have the opportunity to discuss with you Canada's view of the changing trade environment in the Pacific and the priority the Government of Canada attaches to trade development with our Pacific partners.

I first served in Asia in 1974 and I can well remember that Canadian exports to Indonesia were in the order of only $17 million. In 1989 the figure was more than $300 million. I first visited Korea in 1977. My benchmark for progress there is that at that time there were only 2 bridges across the Hawn River in the city of Seoul...today there are 17. Even the most optimistic could not have forecast the incredible pace of change which has surged throughout Asia! Who could have predicted the magnitude of economic muscle formed in Japan, and the emergence of the Four Tigers? In fact, the pace of change continues at such a rate that it is difficult to translate my personal experiences of just two years ago with any accuracy to the scene today.

While I intend to talk about trade in telecommunications today, I'd like to first outline my Government's general perspective on the importance of the region -- what we see happening in the near term and how we are responding to the growth in wealth and influence of our Pacific partners. I would like then to talk a little about the opportunities, challenges and advantages for Canada in doing business in the region, particularly in the dynamic, and vital, telecommunications sector.

Canada is a nation built upon a long history of trading with the rest of the world. In fact, one-third of our G.N.P. is derived from export trade. Our natural resources have traditionally been the principal basis for trade. To a large extent, this is still the case. However, our export economy has increasingly become diversified as evidenced by the success of Canadian high technology firms in some of the world's toughest markets. Just a few facts....

- Northern Telecom is the only foreign manufacturer certified to provide switching equipment to Japan's NTT Corporation.
- Newbridge Networks, a world leader in broadband multiplexing, has formed a joint venture with Sumitomo Corporation to market Newbridge products in Japan.
- Glenayre Electronics Ltd. has achieved a 25% market share in paging terminals in the major markets of the Pacific Rim, and a minimum of 60% market share in the Middle East.
- Mobile Data International (MDI) has been awarded major contracts ($25 m) by Hong Kong's Hutchinson Corporation to supply terminal equipment in both Britain and Hong Kong.
- Telus Corporation (NOVATEL) is the number two supplier of cellular telephones in North America.

There are many reasons for the growth and strength of our trade and investment relationships within the Asia Pacific region. Canada has a reputation for stability, both politically and economically. Our companies are regarded as dependable, adaptable long-term partners. We are known as a conservative society, yet respected for our strong multicultural traditions.

We strongly believe that our economic future is inextricably linked to the economic success of the Pacific nations. Joe Clark, Canada's Secretary of State for External Affairs and International Trade stated, in 1986, that "We recognize as national policy, that our future prosperity is tied to the Pacific".

Our trade policy is fluid, as we believe that no nation is immune from either the vagaries of the marketplace or the impact of decisions made by other nations. As one indication of this attitude, we are an active member of the Asia-Pacific Economic Cooperation Forum, and view this association, and others, as vital to trade development within the region, especially in the realm of multilateral trade policy and dispute resolution.

It may be helpful to review a few of the bold facts which have shaped our views of the economic importance of the Pacific Basin.

By the year 2000:

- 70% of all humanity will live in the Asia Pacific region
- Asia will produce at least 40% of all the world's goods and services;
- the major Pacific countries will grow faster than the OECD countries for the next 20 years, resulting in a minimum of 35% of the world's consumption needs;
- Canada's trade with Asia will continue to outpace trade with Europe.

Canada's framework for trade development has been systematically developed. The Government has adopted broad strategies and action plans which are country specific. We have had trade representation in all Pacific Rim countries since 1945, in total 70 Trade Commissioners in 19 Embassies and High Commissions. We have aggressively expanded trade offices in the region, specifically Osaka, Shanghai, Bombay and Auckland and are in the process of opening additional offices in Japan and Korea. Joint business co-operation councils have been formed with Japan, China, India, Indonesia, Korea, Taiwan and the ASEAN.

A principal element of our overall trade strategy has been defined in a policy known as "Going Global", announced by Prime Minister Mulroney in Singapore in 1989. The three pillars of the strategy are the implementation of the Free Trade Agreement with the U.S., the challenge of Europe 92 and the opportunities presented by the dynamics of the Pacific market.

Our U.S. strategy is driven by the fact that trade with the U.S., at almost $100 billion in 1989, represents 70% of all Canadian exports. The Free Trade Agreement (FTA) between Canada and the U.S., effective in 1989, has stimulated trade, eased tariff restrictions and increased investment in both countries. Our U.S. trade development strategy is designed to help Canadian companies take advantage of opportunities provided by the FTA. Also, discussions are underway, led by Mexico, to determine the viability of expanding the current FTA Agreement to include Mexico as a partner in a trilateral Free Trade Agreement.

Western Europe, especially the European Community (EC), has traditionally been a strong trading partner with Canada. More than 7% of our exports went to Western Europe in 1989. The advent of EC92 is increasing the power and cohesiveness of the EC countries as the economic driver of the region. The increasing likelihood of more substantial British involvement in the EC92 process, and the interest being expressed by other Western European nations, such as Austria, Turkey and Sweden, in joining EC92 suggests that an economically integrated European Community will be a major trading force in the global community.

In what many call the "Pacific Century" Canada is working to secure a prominent place in the arena of international political consultations as related to the Pacific economic system. While slow in developing our relations in the region, we are convinced that the Pacific Basin is now, and will remain, a cornerstone of Canada's trade development policies and actions. For the first time, in 1985, Canada's trade across the Pacific Ocean exceeded our traditional trade across the Atlantic. In 1989, Canadian exports exceeded $16 billion, and we expect this trade to reach $30 billion by the year 2000.

Our Pacific strategy is known as "Pacific 2000", and represents a multi-faceted commitment to strengthen relations with Asia Pacific countries. The objective is to enhance the ability of Canadians to compete in the dynamic and complex Pacific marketplace, and to position Canada as a prominent player in Pacific regional affairs.

As one example of the importance given to the Pacific region, we have created a $14 million budget allocated for the development of "Asian languages and awareness". Canadians are regrettably not very well equipped to handle the expanding range of Asian relationships in terms of language, culture and business practices. To illustrate, we have only about 1,200 Canadians studying the Japanese language. Australia has 20,000, and most major cities in Australia are further from Japan than is Vancouver! The day is rapidly approaching when our major partners in the Pacific will expect more communication in their own languages. Language ability will become a major competitive edge. We intend to do much better in this regard.

As a further example of our commitment to increase the competitiveness of Canadian industry within our three major market regions, Canada has focused significant resources on the development of science and technology (S&T) agreements with most of our major trading partners. S&T is as much an exchange commodity as currency, and will determine the success and competitive edge of both companies and countries. S&T agreements range in scope and complexity. An agreement signed by Japan and Canada in 1986, which currently involves 85 co-operative projects ranging from agriculture to space technology, is typical of our intent. There are also more than 250 sectoral S&T arrangements between Canadian agencies, both Federal and Provincial, and their counterparts abroad.

So what should all this mean to you, particularly with regard to telecommunications?

I do not intend to go through a litany of Canada's numerous achievements in telecommunications, as I assume most of you are familiar with the story. However, it is important to briefly discuss the basic structure of the Canadian Telecom industry, and provide some views on its major strengths and weaknesses, in order to place our trade development strategy for the sector in context.

Canada's position as a leader in Telecom dates back to the completion of the Transcontinental Railroad in 1885, and the associated Telegraph Network. A historic separation between telegraph and telephone companies has been preserved in Canada so that there are today two national Telecom systems -- Telecom Canada, comprising the major telephone companies, and UNITEL, descended from the earlier railway telegraph companies. Both of these carriers have traditionally been regulated under the "Railway Act", and have faced very little competition until recent years. However, the regulatory environment is rapidly changing, due principally to the deregulation of the U.S. carriers and the FTA, and I expect the competition to increase between these traditional carriers. The expansion interests of the strong cable television sector will also be a major competitive factor for Canadian carriers in the near future.

An important characteristic of the Canadian industry is that it has been traditionally been driven by an engineering approach rather than a marketing approach to providing service to its customers. The Canadian industry has historically been much more committed to providing reliable, high quality service on a universal basis than to marketing a broad range of services. The engineering excellence achieved by this approach has led to the exceptional level of telephone service enjoyed by the 26 million Canadians living in our 9.9 million km^2. These high standards, coupled with a diverse, often harsh, operating environment led to many of the technological achievements of the industry. Further, the engineers developing service specifications for the carriers were often the ones who left to start their own companies, taking their expectation of engineering excellence with them. The resulting small companies were usually successful selling to the major carriers, and a very high percentage of startup companies have been viable enterprises.

The current exporting core of the Canadian Telecom industry is comprised of about 250 companies. This does not include telephone operating companies such as Bell Canada. Northern Telecom Limited is synonomous with telephony in Canada, but it is an anomaly with respect to the rest of the Canadian industry, simply because of its size and range of product. Northern provided almost half of Canada's $2 billion in Telecom exports in 1989. Most of the Canadian industry is made up of small to medium-sized companies, with sales of $50 million or less. Almost without exception, these companies are niche players catering to either a narrow segment of the market, such as microwave, power systems and radio systems and/or marketing their products and services to a limited number of foreign markets.

The size and specialization of the industry is the basis of our trade development approach. The relatively small size (by international standards), the inherent product focus provided by a smaller company, and the well known engineering excellence of Canadian Telecom suppliers results in a wide range of competitive products, sold successfully throughout the world.

The size and specialization just mentioned, however, also represent a major marketing disadvantage facing the industry. The R&D inherent to the Telecom sector, and the expense of effective sales and marketing, represents a major burden for a high-tech company in the $5-50 million range, especially if the company must leave its safe domestic market in order to grow. International Telecom is a competitive market, and growing more so each day. This means that a company must choose its markets and distribution channels very carefully. Unfortunately for many potential customers, it also means that many Canadian companies have chosen not to get involved with larger projects involving funding by the World Bank, Asia Development Bank (ADB), etc.

I should expand that last statement. It is revealing to note that most of the Telecom exports to the Asia Pacific region by these $5-50 million dollar companies are to cash markets such as Japan, Hong Kong, Australia, etc. As mentioned, most Canadian suppliers are niche players. They may be able to supply elements of major projects but they are not large enough to bid as prime contractors. Nor can they afford the marketing costs associated with the typical procurement cycles of major development bank projects. This anomaly has sparked some interesting "marriages". For example, a Japanese trading house bid a totally Canadian cellular and rural telephony systems package as a response to a South American opportunity. I recognize the necessity for such arrangements and applaud the initiative of the companies involved.

As I mentioned, our trade development strategy places a high priority on Telecom. It respects, and reflects, the diversity and characteristics of the sector in Canada. The strategy is flexible enough to assist companies in penetrating major markets and also to deal with assistance projects to developing countries, which is a major Canadian priority. The key elements of Canada's funded trade development approach are:

- Program for Export Market Development (PEMD), designed to financially support Canadian companies in travelling to foreign markets to identify opportunities, attend trade shows, identify and establish distribution channels, etc.

- Country-specific market studies and assessments are commissioned to identify Telecom opportunities.

- Focused trade missions designed to match the Telecom needs of a specific country with appropriate Canadian suppliers.

- Sector marketing expertise is available to advise companies, one-on-one, with respect to market strategy and initiatives tailored to their requirements and capabilities.

- Sector-specific databases are developed and distributed by our Embassies and High Commissions to key foreign buyers for use as sourcing tools to identify Canadian Telecom capabilities.

- The Technology Inflow Program (TIP)is designed to assist the typical Canadian high tech company to identify appropriate foreign technologies and, to a modest degree, provide financial support for some activities related to the acquisition of needed technology.

A key element in the success of our trade programs is Canada's network of over 800 Trade Commissioners at home and abroad, serving in more than 110 countries. Experienced Trade Commissioners serve in our posts abroad, and are complemented by key sector marketing experts based in Ottawa. The initial identification of opportunities, market assessments, country-specific strategies for market development and direct marketing assistance is available for use by any Canadian Telecom supplier simply on request. In effect, this provides a smaller Canadian company with a source of direct market intelligence without the necessity of stationing personnel in a given market full time, thus allowing the company to make the marketing dollar go further. To illustrate the last point, a Canadian company can ask any one of our Embassies to verify the credentials of a potential agent or to suggest a short list of potential distributors for their particular market niche (a very useful service in some markets). Trade Commissioners also serve as information conduits and, if necessary, guides in the process of "partnering", whether this involves joint ventures, strategic alliances, foreign investment or simply distribution agreements. Trade Commissioners also serve as key sources in facilitating government to government contacts.

I must also mention three other Government agencies that play a role in Telecom trade development. The Export Development Corporation (EDC) is a financing body which provides a variety of financing options to foreign buyers, ranging from basic commercial packages to concessionary financing to developing countries. EDC currently has more than $90 million in concessionary funds dedicated to Telecom projects in China and Indonesia, as one example.

The Canadian Commercial Corporation (CCC) is an important vehicle to support trade for Canadian companies in certain parts of the world. CCC will act on behalf of Canadian companies as the contracting agency with the foreign government buyers, guaranteeing the funds to the supplying Canadian company, which essentially eases their cash flow situation and lessens their risk exposure.

The Canadian International Development Agency (CIDA) supports many infrastructure projects to developing nations around the world. As one example, CIDA is funding the development of a rural telephony project in the Philippines which will see more than 200 villages receive their first telephone service by the end of 1991. Within CIDA's 1989 budget of $2 billion, more than $60 million was directed at the Industrial Cooperation Program (CIDA INC) which assists Canadian companies to undertake investments, joint ventures and skills transfer activities with partners in developing countries. Since its inception just over 10 years ago CIDA INC has assisted over 1600 Canadian companies in more than 100 countries. In 1989, more than one-third of all CIDA INC disbursements were directed at activities in the Pacific region.

As mentioned, trade development for telecommunications cannot be conducted in isolation. In addition to the capabilities and marketing desires of the industry, our activities must take into account factors affecting the overall trade environment. For example, in the Pacific Basin Canada must be cognizant of the huge capital pool in Japan, Korea and Taiwan, the individual growth and growing interdependence of the major Asian trading nations, and the occasional presence of protectionism (not strictly a Western phenomenon). The general increase in quality and value of products made in the region increase their appeal to consumers in Canada. These factors, and others, form a constantly changing backdrop to our planning as we endeavour to develop an effective, yet flexible, trade development program.

You can see that is is becoming more difficult to view trade development as a series of individual, albeit related, programs which can be viewed as isolated elements of an overall strategy. Trade development, technology transfer, R&D programs, foreign investment, tariffs, trade barriers and export financing are increasingly inter-related. I wish I could say that we have all the issues clearly defined and the transition plan which seamlessly addresses all concerns in place. I can't. What I can say it that we recognize that the world market is rapidly changing, that Canadian companies have much to offer and that it is our job to help them prepare to meet the challenges of a global market.

Canada will continue to give priority to trade development within the Pacific region and encourage foreign investment in Canada. We will work to ensure Canadian competitiveness through our S&T activities. We will continue to welcome and provide assistance for principals willing to develop alliances with Canadian companies, such as joint ventures.

Thank you for your time and attention. I have enjoyed my discussions with you prior to today and I hope the opportunity presents itself to meet with you again. Aloha.

OPEN NETWORKS, THE EARLY LESSONS

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Abstract

Regulators and public policy makers face unique challenges as they move their national telecommunications industry into the emerging global, competitive, information telecommunications industry. Open network initiatives such as Open Network Doctrine, Open Network Provision and Open Network Architecture promise to change the business practices of telephone companies with respect to the operation of and competition with Private Service Operators and Enhanced Service Providers. This paper examines the status and impact of the open network initiatives worldwide.

Introduction

In many nations, traditional regulation has served the public well over the first 100 years of telephony. Individual nations chose to regulate or otherwise manage the implementation of its voice communications system consistent with national goals. The motivation for such regulation was to ensure that the desired result would not be left to chance. In some nations, the widespread availability of "public" as opposed to "private" telephony was the paramount goal: in other nations the development of a business capability was foremost. While, each provided a "platform" for the orderly, in some cases slow development of the essential elements of nationwide telephony, there was generally no linkage between those investments. This may explain why the ability of public networks to provide data transmission services has lagged behind the needs of the computer industry and its customers. That national view of telephony is no longer valid. Communications capacity and capability has grown to a point where any nation that aspires to the "highest standard of living" must create and maintain an "information services infrastructure" for people and enterprise. The global nature of today's competition requires nothing less. The modernization and migration of the public telephone network towards that goal (i.e., to become the information services infrastructure) requires a newer view of, and for, regulation.

"Opening" and otherwise expanding the availability and use of public networks (i.e., open networks) will bring benefit to telephone companies, residential and business users, value added companies, schools and government, in short, all segments of society. Telephone companies will invest in the facilities that create the access to the network functionalities needed for new and innovative services. Companies that have ideas and resources for new and innovative services will utilize the open networks to quickly bring them to market. Customers will use the services and thereby generate the new revenue needed to sustain the open network process.

Open Network Initiatives in Asia-Pacific

In 1985, Japan privatized the telecommunications market and, since then, has slowly opened its market to private operators and foreign competition. Type I Network access service for private (enhanced) service operators is mainly provided by the Nippon Telegraph & Telephone Corporation (NTT) in the domestic market. Network facilities for international private service operators is provided by Kikusai Denshin Denwa (KDD), International Digital Communications (IDC) and Japan Enhanced Network Services (JENS). NTT and KDD are free to compete in the private service area and have done so successfully. In 1988, there were 550 General Type 2 Value Added Networks (VANs) registered with Japan's Ministry of Posts & Telecommunication (MPT). NTT Data Communications is currently the industry leader.

As part of the its plan to restructure the operations of the NTT, Japan's MPT announced its Open Network Doctrine (OND). MPT described it as the "blueprint for increasing competition in the domestic market and allowing equal access to the public network for the supply of electronic services.[1]" On 2 October 1990, the Japanese MPT started a proceedings that announced further action regarding the OND proposal. This proceeding specifically requests "A hearing [comments to be filed with the MPT] of opinions from concerned people [to include foreign government] regarding preventive measures for anti-competitive practices when value added telecommunications services are offered by Type 1 Telecommunications Carriers[2]." Commenters are asked to consider "Whether or not anti-competitive practices exist when Type 1 Telecommunications Carriers provide value added telecommunications services" with respect to specific issues. These issues include cross-subsidization, predatory pricing, disclosure of client information and otherwise discriminatory treatment of competing VANS.

Telecommunications services in Hong Kong are provided by the Hong Kong Telephone Company, LTD. (HKT) and Cable & Wireless Hong Kong, LTD. (CWHT). HKT provides the local telephone service. CWHK provides the international voice and data as well as the Territory's leased voice and data services. HKT and CWHK are the exclusive operators in those markets. VAN type services can be competitively provided by HKT and CWHK, or another licensed provider. Licenses for VANs are available from the Postmaster General, upon the applicant demonstrating that the new service(s) will add value to basic network services.

Other nations in the region have also started to move to a more open network policy. Korea and Malaysia are notable examples. The current state of telephone service will be an important factor when public policy is implemented. For example, nations with less developed national telecommunications networks may be focusing on improving coverage and the quality of public telephone access (e.g., universal service). Open networks and competition may provide an alternative to the traditional approach of empowering a single company, under regulatory control, to provide nationwide telephone service.

Open Network Provision in Europe

In Europe, the European Commission (EC) has embarked upon a process for changing the existing regulatory framework to foster a technically advanced European-wide telecommunications network, providing the essential infrastructure necessary for improving the competitiveness of the European economy. One of the key concepts in the implementation of the competitive European environment, as outlined in the "Green Paper," is the creation of a common definition of an agreed set of conditions for Open Network Provision (ONP).

ONP is aimed at creating within Europe a process by which regulated network services may be offered to users and competitive service providers (e.g., Private Service Operators [PSOs]). Once established ONP would stimulate the development of competitive services; promote fair competition between Telecommunications Administrations (TAs) and PSOs; and at the same time not lead to the gradual erosion of the current position of the TAs in the overall marketplace. This differs from the United States proposal for implementation of open network, (i.e., Open Network Architecture [ONA]). In the U.S., the Federal Communications Commission (FCC) has not limited ONA to any specific set of basic services. It is the opinion of the authors that the provision and use of open network services will benefit from the complete interaction among marketplace forces.

On 2 February 1990, a Council Directive was adopted regarding the establishment of the internal market for telecommunications services through the implementation of ONP. This Directive sets forth a specific timetable for the introduction of ONP to various service areas. Work will be undertaken to implement the following in 1990, 1991 and 1992:

- adopt specific directives covering leased lines and voice telephony;
- implement, by 1 January 1991 harmonized technical interfaces and/or service features for packet-switched data services and Integrated Services Digital Network (ISDN);
- adopt, by 1 July 1991, a recommendation on the supply of technical interfaces, conditions of usage and tariff principles applying to provision of packet-switched data services.
- adopt, by 1 January 1992, a similar recommendation for ISDN; and
- undertake a study of a proposal to develop a specific directive on packet-switched data services.

It is important to note that this Directive calls for the establishment of harmonized conditions for ONP as a progressive process that must be prepared with the assistance of a committee composed of representatives of the Member States, having input from representatives of telecommunications organizations, the users, the consumers, the manufacturers and the service providers.

Open Network Architecture in the United States

On 15 May 1986, the FCC adopted an order that sought to develop an Open Network Architecture that would eliminate the need for structural separations between Regional Bell Operating Company's (RBOC's[3]) telephone company (BOC) undertakings that provided basic service from those providing enhanced service. Under this order, if AT&T or a BOC wishes to provide, in the near term, a specific enhanced service[4] on a structurally unseparated basis, it must provide Comparably Efficient Interconnection (CEI) to the underlying basic network for competitors wishing to offer the same enhanced service. Such basic services must be available to other Enhanced Service Providers (ESPs) in a nondiscriminatory manner. In the longer term, unbundled basic services should be available to others whether or not BOCs use them to provide any enhanced services.

On 1 February 1988, NYNEX and the other RBOCs filed ONA Plans with the FCC. These plans described the process for identifying and evaluating ESP customer requirements and the manner in which those needs were to be satisfied. A principal feature of the plans was an ONA Model that afforded a common, i.e., standardized, approach to unbundling the network capabilities for the use of ESPs. Basic serving arrangements (BSAs) and basic service elements (BSEs) were created for each of the four categories of network services (i.e., voice grade circuit switched line, voice grade circuit switched trunk, packet switched and private line). BSEs were provided in each basic category. In its filing, NYNEX declared that any enhanced service that was offered by the NYNEX Telephone Companies would utilize the underlying network capabilities (i.e., the BSA and BSEs) under the same terms and conditions that are offered to any competing ESP. There would not be a separate tariff rate for telephone companies, all ESPs would pay the same price. In this way, the ONA Plans sought to provide a "level the playing field" for all providers of enhanced services.

Individual BOCs have determined that new ONA services are beneficial to the overall operation and revenue enhancement in the regulated market. These telephone companies have sought ESP industry input to decide which ONA services are required for emerging information services. Many industry forums have been held to facilitate dialogue between the BOCs and the ESPs. In response to the demands that BOCs received at the forums and other meetings with ESP customers, the BOCs included in their ONA Plans many of the capabilities requested. In addition, the BOCs filed CEI plans so that new information age services could be offered to the public. (CEI is the interim process for service introduction, pending the final adoption of ONA.) Thirty Five (35) CEI plans have been filed with the FCC, thirty (30) have been approved, which provide ONA basic services to support ESP provision of various enhanced services. In the U.S., ONA service will provide new network access to providers of enhanced services (e.g.,message storage, voice messaging, protocol processing).

ONA and ONP - Emerging Regulatory Principles for Open Networks

Open network initiatives will provide PSOs and ESPs with the ability to employ the basic telecommunications network in new and more efficient ways, thus improving their competitiveness in international markets. If these initiatives are to be successful and, equally important, if they are to be of value in establishing information age services, they must establish a level competitive playing field for both the users and suppliers of communications services.

Worldwide, regulators and public policy makers should consider certain principles as open network initiatives are planned and implemented. Analysis of the ONA and ONP initiatives has shown the following principles to be consistent and critical for success.

Principle No. 1 Fair and Open Procedures:

Open network services and capabilities should be identified, selected, developed and made available pursuant to fair and open procedures. All users (e.g., PSOs and ESPs) should: have the ability to request new network services and capabilities without compromising the confidentiality of proprietary information; be provided with a response to their requests in a timely manner; and, to the extent that requested network services and capabilities are not made available, be provided with a means of appeal consistent with national practice.

Principle No. 2 Nondiscrimination:

Open network services and capabilities should be made available to all on a nondiscriminatory basis, should not be subject to use or user restrictions. Open interfaces should exist for the interconnection of customer premises equipment (CPE). An open network service or capability used by a TA or an affiliate in providing a competitive service should be equally available to unaffiliated third parties pursuant to the same nondiscriminatory rates, terms, and conditions. Customer and technical network information should similarly be made available to unaffiliated third parties pursuant to the same nondiscriminatory rates, terms, and conditions that such information is made available to the TA's own competitive service operations.

Principle No. 3 Uniformity:

Open network services and capabilities provided by TAs should be made available on a uniform basis within individual countries both regionally and internationally. Uniformity should extend to nomenclature, functionality, technical capabilities, rate structure, provisioning, and the types of services and capabilities that are made available. Ubiquity of open network services and capabilities should also be a goal.

Principle No 4 Unbundling of Network Services and Capabilities:

Open network services and capabilities should be made available on an unbundled basis to the extent that it is technically feasible and economically beneficial to do so (i.e., the technology is at hand and sufficient marketplace demand exists to recover the costs of providing the unbundled service or capability). Customer premises equipment should not be bundled with network services.

If a TA uses unbundled network services or capabilities, these offerings should be made available to unaffiliated third parties on the same unbundled basis. A well-conceived open network initiative should also provide TAs with an economic incentive to offer unbundled network services and capabilities in addition to those that may be required for their own use.

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Principle No. 5 Pricing:

Open network services and capabilities should be priced with regard to costs. Departures from such pricing should be discouraged and, where they exist, a commitment should be made to align prices with costs over time. Costs should also be recovered in the same manner in which they are incurred. If the costs of providing service (e.g., private leased lines) are fixed, these costs should be recovered on a flat-rate basis. If costs vary with usage, they should be recovered through usage-sensitive charges. Furthermore the price of a network service or capability should not vary depending upon the purpose for which it is used whether the service or capability is used in connection with domestic or international communications. TAs should adopt mechanisms, consistent with their regulatory framework, which ensure that open network services and capabilities are priced with regard to costs. Moreover, to the extent that a TA is engaged in the provision of a competitive service, it should acquire open network services and capabilities at the same price that such services and capabilities are made available to unaffiliated third parties.

Principle No. 6 Network Evolution:

Open network initiatives should not be a one-time event. Investment decisions, the deployment of new underlying network technologies, and network planning and engineering should be conducted with a view toward introducing new open network services and capabilities. Technology should provide users with greater options and functionality over time.

ONA and ONP: What has been learned, so far?

It is imperative that PSOs and ESPs participate in the development of open network services. Open network services must not be determined solely by TA engineers predicting the likely track of technology. Nor is it appropriate for regulators to determine what is needed for the information age. Instead, a process is needed that will balance the near term market pull requirements against the longer term technology push. Technology can provide an ever expanding menu of opportunities for services and applications. PSOs and ESPs must be able to pick and choose from that menu to build information services. As the information service provider, these companies have the best view of what the customer (i.e., end user) needs.

TAs can start this process by organizing seminars to provide existing and potential customers with information on the operation and capabilities of the telephone network. PSOs and ESPs should then be encouraged to request various applications of telecommunications technology for service designed to provide their customers with these new and innovative information services. As these services will be fundamentally different from traditional telephone service, the potential for bypass is lessened.

Decisions made by TAs to provide certain requested services must be based upon sound economic and technical foundations. Otherwise marketplace acceptance will likely be lost.

The open network initiatives in Europe and the U.S. were started by centralized regulatory groups. The EC and the FCC developed the initial concept of an open network regulatory regime. Now that this implementation is beginning, the local regulators have become very interested in the potential impact of open network services upon local TA revenues, because these revenues are used to subsidize universal telephone services and, in some jurisdictions, other social programs.

In the U.S., the FCC has initiated a Joint-Board Conference (state-federal) proceeding to address the impact upon existing access services. This group will recommend whether new rate elements and sub-elements are appropriate for ONA related access services. The EC in its latest ONP Directive has deferred the "rates and tariffs" questions to the national regulatory body.

Close coordination between central and local regulators is essential so that cost and rate disparities between jurisdictions can be minimized. The TA's transition from the tightly regulated national service provider to the competitive global service provider must not sacrifice "universal service." The creation of the information age network infrastructure, made up of competitive and regulated TAs, PSOs and ESPs, should include access for all segments of society from the smallest residential user to the largest business customer.

Open Networks - Recent developments, has the process been slowed?

In Europe, the Council of the EC issued a Council Directive[5] for the establishment of the internal market for telecommunications services through the implementation of Open Network Provision (ONP). This document known as the ONP Framework Directive was adopted by the Council on 5 February 1990. Notification was given to the Member States on 12 July 1990.

The Services Directive contains 12 Articles that concern the "harmonization of conditions for open and efficient access to, and use, of public telecommunications networks and where applicable, public telecommunications services[6]." They form the common basis or framework for the development of measures for specific services (e.g., leased lines, packet switched data, and voice telephony) offered by telecommunications organizations[7]. In that regard, the directive spells out the qualities of open network provision and assigns the responsibility of implementation to the service providers and regulators.

Viewed in the context of the foregoing "emerging regulatory principles for open networks" the impact of the Services Directive can be effectively analyzed.

Fair and Open Procedures: Article 3 requires that ONP conditions must be transparent. A work program shall be established to prepare reports about the areas (e.g., leased lines, voice telephony service) for which ONP conditions would apply and invite public comment on these specific reports (Article 4). Harmonized technical interfaces and/or service features for ONP shall be published in the Official Journal of the European Communities. The Council Directive states, "Whereas the establishment of harmonized conditions of Open Network Provision must be a progressive process and must be prepared with the assistance of a committee composed of representatives of Member States, which consults the representatives of the telecommunications organizations, the users, the consumers, the manufacturers and the service providers: whereas this process must be open to all parties concerned and therefore sufficient time must be given for public comment." However, no specific organization or process has yet emerged in response to this statement. Direct user participation is not contemplated, though provision has been made for consultation.

Nondiscrimination: Article 3 states ONP conditions must be nondiscriminatory and may not allow for any additional restrictions on access or reuse except, or unless, "special or exclusive rights[8]" have been granted by Member States and are compatible with Community Law. The Member States shall notify the Commission of the bodies to which they have granted special or exclusive rights.

Uniformity: ONP technical interfaces must, wherever possible, be in accordance with ongoing work in CEPT, CCITT, ETSI and CEN-CENELEC[9]. ONP supply and usage conditions shall identify harmonized conditions of access and provision of services that are harmonized, as far as required. Tariff principles must be consistent and harmonized.

Unbundling of Network Services and Capabilities: This directive does not discuss unbundling nor did the "Green Paper." Unbundling of existing network elements has not been a part of the ONP program[10]. This directive does provide some information regarding the development of service interfaces. It states, for existing services and networks, existing interfaces should be used. This seems to strengthen the conclusion that unbundling will not be implemented as part of ONP.

Pricing: The document recommends that tariffs must be based on objective criteria and must be, in principle, cost-oriented. Responsibility for the rates will continue to be the province of national legislation and is not the subject of ONP. Tariffs must be non-discriminatory, guarantee equality of treatment and take in to account the principle of fair sharing of the global cost of the resources used while recognizing the need for a reasonable level of return on investment. In many Member States considerable work needs to be done if "true" costs are to be oriented with price in the near term. Also the Directive does not discuss the relationship of cost to use. This may leave room for the imposition of usage charges for services which were otherwise based on fixed costs.

Network Evolution: The Directive calls for further study[11] of new types of network access, (e.g. data-over-voice technology, intelligent network functions and broadband networks).

This Council Directive is an important step in the process of creating ONP in the European Community. The policy perspective set forth in this document strikes a balance between the future goals of the EC and the nearer term realities of the entrenched service providers and regulated services.

In the United States, the FCC on 12 April 1990 approved the ONA Plans of NYNEX and the other RBOCs[12]. Structural separation requirements will be removed upon notification that each BOC is technically prepared to offer each of its initial services, federal tariffs for each are in effect and it has filed state tariffs. In its order the FCC reaffirmed that ONA is an evolutionary process and the most significant implementation will take place in the future. The Commission recognizes the importance of new technologies for ONA services. It required that the BOCs supplement their plans to describe new ONA services that will be possible as Signaling System #7, ISDN and Intelligent Network technology are deployed in the public switched telephone network (PSTN).
In a related ONA matter, on June 6, 1990, the 9th Circuit Court in San Francisco issued an order in the case of the People of California v. (versus) FCC that vacated a decision of the FCC to permit the BOCs to integrate their regulated and unregulated activities. Further, the Court held that the FCC's order preempting state regulation of Enhanced services was not justified.

ONA was initiated as part of the FCC's Computer III proceeding. Current non-structural arrangements granted under the pre-ONA, i.e., CEI process, are to be continued. The FCC appears determined to implement ONA. As such, it will begin the requisite administrative proceeding to develop the additional information needed to satisfy the Court. Mr. Alfred C. Sikes, Chairman of the FCC, released a statement[13] which addressed the commitment and need for ONA. He said, "ONA is a linch-pin of this nation's [United States] overall telecommunications policy -- and our network of the future. The court's opinion in no way criticized the development of ONA. Nevertheless, in case there are any doubts regarding this initiative [ONA] raised by the Ninth Circuit's ruling, we need to, and will, act decisively to resolve this issue." With respect to State-Federal interrelationships the FCC does not plan any direct action but Mr. Sikes has said, "the FCC is not prepared to acquiesce to actions that could compromise the further development of new customer choices and competitive information services [enhanced services] on a nationwide [United States] basis." The industry movement to ONA will not be derailed by the Court's action, but it may be slowed. Current CEI (pre-ONA) service arrangements continue to be available, albeit under waiver. New enhanced services are not being considered for deployment, and this may cause the development of additional ONA services to slow.

Conclusion

Regulators and public policy makers face unique challenges as they move their national telecommunications industry into the emerging global, competitive, information telecommunications environment. Open network initiatives such as Open Network Doctrine, Open Network Provision and Open Network Architecture promise to change the business practices of TAs with respect to the operation of and competition with PSOs, VANs and ESPs.

The major stakeholders in the development of open networks are the PSO and ESP, the regulators and the TAs. Each has particular concerns. The PSOs and ESPs desire the aggressive implementation by the TAs of open network services. These services should be provided from an entrepreneurial perspective. According to the PSO and ESP, the TAs should bear a larger part of the risk in developing and deploying new services and should not expect to keep their cost low by providing only access to existing services. The TAs are anxious to provide new open network services, spurred by the promise of increased network usage and the potential for information services revenues from their PSO/ESP-like operations. The TAs believe that open network services should be technically feasible and economically viable. In addition, any new open network service should not be a duplication of a currently tariffed service but rather a new application for the emerging PSO/ESP industry. The regulators are concerned with the erosion of the revenue base and the subsequent impact on social imperatives, such as "universal service."

The development and implementation of open network initiatives in Europe, the United States and Asia-Pacific regions will continue and probably accelerate. Expanding the capability of public networks to provide the access to consumers and information providers will benefit society. Lower cost of communications and information will enhance the competitive ability of companies and individuals in that society. The global village will benefit as countries facilitate the access to information regardless of national boundaries. The promise of a ever increasing market is the reward for those who dare.

The success of these undertakings will be directly proportional to the ability of regulators, PSOs and ESPs, and TAs to realign their operations to conform with the new realities of rapidly advancing technology and the worldwide competitive marketplace.

Footnotes:

(1) 7 May 1990 Communications Week International, Denis Gilhooly - page C3

(2) 2 October 1990, Data Transmission, Telecommunications Business Department, Bureau of Telecommunications, Ministry of Posts and Telecommunications, 1-3--2 Kasumigaseki, Chiyoda-Ku, Tokyo 101-90 Japan

(3) NYNEX, Ameritech, Bell Atlantic, BellSouth, Pacific Telesis, Southwestern Bell Corporation and U S West were formed as part of the Modified Final Judgement, i.e., the AT&T divestiture agreement between AT&T and the United States Justice Department.

(4) The FCC, during its Second Computer Inquiry proceeding, determined that certain services could not be offered by regulated telephone companies unless offered in a fully separate subsidiary. These designated services were defined as these employing computer processing applications that: act on the format, content, code, protocol, or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different or restructured information; or involve subscriber interaction with stored information. In its 15 May 1986 Order, the FCC observed that enhanced services had not yet reached the marketplace and determined that the RBOC structural separation requirement was partly responsible. Therefore, it recommended that structural separation be replaced with new non-structural safeguards.

(5) Commission Directive On Competition In The Markets For Telecommunications Services, Commission of the European Communities - C(90) 703 final Brussels

(6) Article 1, page 7

(7) The ONP Framework Directive is somewhat vague on the issue of entities that will be bound by the provisions of ONP. Earlier drafts of the document included explicit language limiting application to telecommunications organizations (TOs) which are granted special or exclusive rights and listed specific European TAs in an annex. The same limiting language is not present in the current version, which raises the specter that ONP requirements may also be applicable to entities that do not enjoy special or exclusive privileges.

(8) " 'Special or exclusive rights' means the rights granted by a Member State or a public authority to one or more public or private bodies through any legal, regulatory or administrative instrument reserving them the right to provide a service or undertake an activity."

(9) European and international standards bodies

(10) Unbundling of existing network services can provide competitive service providers and other users with access to needed network functionalities not otherwise available. The menu of ONP provided services needs to reflect market demand to the extent that such services are technically feasible and economically beneficial.

(11) Investment decisions, the deployment of new underlying network technologies, and network planning and engineering should be conducted with a view towards introducing open network services. The Directive defers consideration of new technologies until significant portions of ONP are in place. This may limit the effectiveness of network evolution as a facilitator for the development of new open network services.

(12) Federal Communications Commission, USA - CC Docket No. 88.2 Phase I, Adopted 12 April 1990, Released 8 May 1990.

(13) 31 July 1990 letter from Alfred C. Sikes, Chairman Federal Communications Commission - USA to Honorable Edward J. Markey, Chairman, Subcommittee on Telecommunications and Finance, House of Representatives, United States Congress

SYMBIOTIC RELATIONSHIPS
A KEY TO SEAMLESS GLOBAL DATA NETWORK SERVICES WITHIN EXISTING REGULATORY CONTRAINTS

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1.0 Abstract

The relaxation of the regulatory environment that has recently occurred in value added network services in many countries has made it possible to establish global Value Added Network Services (VANS) such as the Global Network Service (GNS) of British Telecom. These VANS offer a large number of new services and products. One very significant part of this service offering is the acceptance of end-to-end responsibility for the provision of service across country borders.

The provision of service and the support of customers that have geographically dispersed needs in a number of countries with a spectrum of regulatory environments presents the global value added service provider with a variety of problems. In the cases where regulatory environment have not been relaxed, more creative arrangements have been necessary to offer the services in these areas.

This paper will review some of these services and the arrangements that are used to offer them.

2.0 Introduction

Most telecommunications administrations offer only the standard services defined by the CCITT over their data networks. These are X.25 and Async. In a few cases some IBM capability is also offered. Although satisfactory for a large part of the value added services user population, this limited number of services does not satisfy many larger global users.

The deregulation in Europe, the United States, Canada, and parts of the Pacific Rim has allowed the provider of Global Value Added Network services to establish a physical presence in the country and provide end-to-end services and a number of other services. Services such as such as centralized billing, reverse charging, global neumonic addressing, non CCITT protocols, protocol conversion and other services. The methods that are used to provide these services depend upon:

- The degree of deregulation that exists in the country

- the capability of the Public Data Network (PDN) in the country

- The desire of the administration to offer these services.

3.0 Providing the Widest Variety of Service Offering.

The tendency to consider Global VANS like telecommunications carriers, in which one carrier can supply the needs of a market I feel has been proven to be incorrect. The Global VAN service providers offer a large number of different services to their customers many specializing in one aspect or another of the market. The service is more analogous to a commercial business where a customer is best served where he can freely chose from the offerings of many different service providers.

Each Global VAN has some unique products that it provides. Here are a few of the services that British Telecom provides beyond the CCITT basic services provided by the more traditional Telecom Administrations.

3.1 Direct Interfacing to Protocols

Where most networks require black boxes to interface between terminals that are not ASCII or X.25 terminals and a packet network, British Telecom found a substantial saving to the user to directly handle non CCITT protocols by providing all the necessary interface programming in the node by which the terminal or host computer has gained access to the network. Protocols such as the Airline Reservation Protocol (ALC/2946) is an example of a protocol that BT Tymnet handles directly and is of interest to a global community. Other protocols that we have implemented directly are Universal Terminal System (UTS) of Unisys, Burroughs Polled Select (BPS), IBM SNA protocol, RJE/HASP, 3270 Bisync as well as ASCII, X.25 and X.75.

3.2 Protocol Conversion.

The normal view of protocol conversion with respect to packet networks is async to X.25. However in the marketplace this has proven to be much to narrow a view. We have found a substantial market converting protocols directly from one to another such as a 3270 Bisync to ASCII or SNA or to X.25.

3.3 Transaction Services

The need to handle credit card transaction verification very quickly and flexibly for a large number of different card providers was a challenge to the packet network service provider. Since British Telecom is both a packet network service provider and one of the largest credit card processors in the United States, they developed an interesting solution to the problem. The development of multiplexed virtual circuit and the transaction switching logic that looks at the contents of the transaction as it passes through the network and determines the best place to handle he transaction provided the solution. If the normal positive approval hosts are down, backup negative files are provided by British Telecom to clear the sale. In addition the services of Electronic Draft Capture, Transaction Accounting and many other functions are provided within the network.

This is an example of a services it would be unreasonable to expect from a standard packet network with a smaller country .of services, but these types of services become possible within a seamless global network.

3.4 End to End Support.

The key to this service offering is the presence of staff in other countries, or a very close relationship with a packet service provider in that country to provide an end-to-end support of the user. In the typical case we would like to be able to order services for the multinational company in other countries and likewise process orders from other service providers for orders for service on our network. For this to work well a dialogue should be present at a basic operational level so that the tasks may be efficiently completed.

3.5 Effective Pricing

By mutual agreement we have been able to offer Global Prices in a number of locations where calls do not originate and terminate within British Telecom as well as those cases where we are both ends of the call. In these cases we have been able to offer prices such as $24.00 per hour for a call from Europe to Australia.

4.0 Delivery of the Global Value Added Network Services.

In order to effectively offer enhanced services, most International Value Added Network Service providers need to have specific physical equipment available at the location where the service is offered.

The approach of British Telecom to the problem of offering its value added services over the widest possible area is constrained by the desire to make all the services available wherever possible. Since standard X.25 networks do not have the ability to transport all the functionality needed by all the protocols and the other value added services offered by British Telecom, wherever possible British Telecom is placing TYMNET technology equipment in foreign locations either through establishment of a relationship with the PTT or other operating entity with the country or by the establishment of its own operations in the country.

4.1 Tymnet Technology Equipment Locations

The most extensive service offerings exist where TYMNET technology equipment is present. These locations may be served by access nodes that owned and operated by Tymnet, or owned and operated by a local service provider, normally the Telecom Administration in that country. These nodes may operate within the global network of the Tymnet Global Supervisor Computer, or a TYMNET technology network not using the Tymnet Global Supervisor Computer.

4.1.1 British Telecom Operated Nodes

British Telecom operates its own network nodes to supply these Value Added Network Services to the extent that local law allows in: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States.

4.1.2 Administrations Using the British Telecom Global Network.

Currently in a number of countries Telecommunications Administrations or PTTs, operate Tymnet equipment to provide packet services within the country and yet operate using the supervisor computer of the Global Network Service which allows all the additional functionality offered by Tymnet to be utilized.

These locations are: Antigua, Argentina, Austria, Bahamas, Bahrain, Barbados, Bermuda, Cayman Islands, Curacao, Dominican Republic, Guam, Guatemala, Honduras, Hong Kong, Italy, Jamaica, Mexico, Northern Marnias, Panama, Philippines, Portugal, Saudi Arabia, Trinidad & Tobago, United Kingdom, United States, Uruguay, and the US Virgin Islands.

4.1.3 TYMNET Technology Equipment outside of Global Supervision

In other locations Tymnet equipment is used but instead of being under the Global Supervisor Computer, the operating entity has chosen to have its own supervisor computer. This means that upon a customer identifier being entered into the system it is not automatically recognized within the global network, but the other enhanced services are available to the customer in that country. This is true in Australia, Taiwan and Sweden.

All other providers of packet global networks services also need to have their equipment within a country to provide the best level of service to the customer.

4.2 Approaches of other IVANS.

Some of the companies now providing these international services began operations mainly as computer service providers. Some of these companies still have a large mainframe computer service component to their business. I feel that the computer service provision aspect of their business has shielded them from local regulatory issues in several countries.

4.2.1 The GEIS Approach.

The GEIS Network works via the two supercenters in the the United States and one in Amsterdam. They use IBM 3090, 3081, and 4381 CPUs and Bull/NEC based computing service.

GEIS has been present in some of these countries for a long time. For example it has been in Italy since the late 1960s. They currently have a presence in 34 countries. (1)

4.2.2 The Approach Used by INFONET.

In 1985 and 1986 CSC set up several organizations with the PTTs to legally market INFONET in foreign locations. France and Singapore were two locations where this approach was used. It gave customers in these locations synchronous and asynchronous access to the INFONET network. In mid-1988 INFONET took an new approach. The approach that INFONET took was to have the PTTs as their shareholders. With the stock of INFONET being held by 11 carriers they do not have any difficulty in operating in those countries. However most of the countries that are shareholders already have liberal regulations regarding value added networks. The approach is very clever and has allowed them to operate in locations where it is otherwise difficult.

The share owners as of January 1990 were:
MCI, PTT Telecom Netherlands, Regie des Telegraphes & Telephones (Belgium), France Telecom, Deutsche Bundespost, Telefonica (Spain), Teleinvest AB (Sweden), Swiss PTT, Telecom Australia, Singapore Telecom International, KDD(Japan) (2)

5.0 Examples of Problems which have Global Network Solutions.

There are any number of good examples where the solution to the customer problem is more satisfactory as a global solution and not a number of local solutions. These are some general examples of global problems.

5.1 Global Access Validations

The option of having a common access procedure from anywhere in the world is a feature that has been identified as very desirable by many of our customers. While we have not achieved this through the world, we have accomplished it in a large part of the globe.

5.1.1 Global Validations - Convenience or Requirement

In countries where Tymnet technology is used as the PDN and is under the control of the Tymnet Global Supervisor, the name TYMUSA has been reserved. The entry of the identifier TYMUSA will route the user to a gateway that prompts him for his identifier on the British Telecom Global Network. This routes him to the host computer desired on Tymnet and the access is billed to the identifier on Tymnet. This function is available in a total of 37 countries.

The usefulness of this small feature cannot at once be realized. For example, it allows people traveling in other countries to place a data call to to the local PTT or service provider without having to first contact the PTT or service provider for an identifier on the network to do things like:

* Obtain aircraft flight plans

* File news stories (widely used by reporters)

* Access electronic mail systems (the largest usage)

* Order entry and inquiry

Example:

Jeppsensen Dataplan is a wholly owned subsidiary of Jeppensen Sanderson that provides real-time interactive flight routing, weather information, and negotiation for overflight and landing privileges to pilots and flight crews of commercial airlines, corporate aviation departments and military air forces.

Customers connect their terminals or laptop computers with Dataplan's host in Los Gatos, California. Through an interactive dialog they describe the flight. Within 30 seconds, Dataplan responds with a detailed flight plan taking into account weather conditions and the type of aircraft. Most Dataplan customers use the service for every flight leg which their organization files.

Since some Dataplan customers such as corporate aviation departments travel to new countries regularly, it is difficult for them to have the previous business agreements required by some PTTs to access the public data network in that country. They would like a uniform global access procedure so that the pilot would only need the telephone number of the local packet network node.

5.1.2 Global Validations Expedite Aid PC Software Distribution

Another hidden advantage is that the common access procedure allows companies to distribute programs on disks for PCs to users in a large portion of the world without the need to Taylor the disk to each user or even each country. The use of one procedure can cover 37 countries if desired

5.2 Global Reverse Charge Access to Hosts Not On The TYMNET Network.

This requirement came to our attention when a data base provider in Israel approached us with the problem of providing them with a method of having their customers in locations other than Israel access their database in Israel quickly and easily without requiring the customers to contact BT Tymnet and obtain an identifier on TYMNET. The database provider could of course get a Network User Identifier (NUI) on TYMNET and then allow their customers to use it, but that is the same as giving out your telephone credit card number and hoping your customers will only use it to call you.

The solution was to develop a product called TYMVISA. This allows us to issue to the data base provider a NUI such as GOVCONTRACTS which when used will automatically complete the call to that service providers host in the foreign country and prevent access to any other host with the use of that NUI.

5.3 Obtaining NUIs on Other Networks

In conjunction with a installation of service for a customer having requirements in a number of countries some of which British Telecom does not have a presence or in which the TYMUSA product is not available, BT Tymnet has in order to provide a complete service obtained NUIs from PTTs on behalf of the customer. Because of the high administrative cost of this process we prefer to one of the other methods used, but it is available if required.

6.0 Regional Packet Data Network For The Pacific.

The incorporation within the Global Network Service of the Regional Packet Data Network for the Pacific as described by Kelley, Fishman, and Boughton in the paper *"Interconnecting the Pacific Basin with the Global Packet Network: Challenges, Opportunities, and Benefit."* which was presented at the 1990 PTC conference has proved to be an excellent example of this symbiosis. The network is operated by PCI headquartered in Guam and provides all the services that BT Tymnet provides in its network. The most dramatic part of the symbiosis has been making the service affordable.

On Guam for example, PCI has been able to reduce substantially the rates that others were charging.

With the expansion of this network to American Samoa, and other Pacific Island locations many of the cultural and social benefits described in that paper will be realized.

7.0 Eastern Europe

Under an agreement with Radio Austria AG, British Telecom will operate a TYMNET node in Austria under a "one-stop-shopping" agreement so BT can offer BT's End-to-End Global Network Services in Austria. Radio Austria will act as the local support center for GNS.

This agreement provides direct access to the Eastern Bloc countries of Hungary, Czechoslovakia and the USSR.

8.0 Summary

The creation of a seamless Global Network Service that eliminates the communications barriers between countries in the packet data transmission environment will solve the current problems of many customers and provide new opportunities in many fields. This worthwhile goal can only come about by continued liberalization and deregulation of data communications.

References

1. Datapro Reports on International Networks and Services, Deiran NJ, 1990, IN70-147, pp 101-112

2. Datapro Reports on International Networks and Services, Deiran NJ, 1990 IN70-145 pp 101-110

3. Boughton, George J.; Fishman, Eric; Kelley, Robert F. Jr., *"Interconnecting the Pacific Basin With The Global Packet Network: Challenges, Opportunities and Benefit"* Proceedings: Pacific Telecommunications Council, 12th Annual Conference, 1990, Hawaii, U.S.A. pp 558-563

INTERNATIONAL TELECOMMUNICATIONS COMPETITION: PRACTICAL ADVICE TO TELECOMMUNICATIONS ENTITIES AND POLICY-MAKERS BASED UPON THE U.S. EXPERIENCE

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I. ABSTRACT

This paper demonstrates how selected aspects of the U.S. experience over thirty years with competitive telecom markets can be used effectively by carriers and regulators in other nations to prepare for the introduction of limited or full competition.

II. INTRODUCTION

The spread of telecom competition around the world promises to be a pervasive trend in the 1990s. Numerous countries -- including Australia, Canada, Japan, New Zealand, South Korea and the U.K., to name a few -- have introduced competition into their telecom markets or propose to do so in the near future. Many countries have considered or implemented a privatization initiative, an important first step on the road to competition.

As market structure changes, new uncertainties confront telecom carriers and Government officials. Carriers must adjust their short-term and long-term business plans to a dramatically different telecom environment, while regulators must develop new policies to reconcile competition with the public interest. All industry participants require an expert understanding, in advance, of the changes that are likely to occur after the onset of limited or full competition. Such knowledge is critical for new entrants to gain a defensible and expanding foothold in the market, for existing carriers to maintain market position and maximize long-term profitability, and for regulators to develop effective policies which require the fewest revisions over time.

A premise of this paper is that the U.S. experience with competitive telecom markets provides a reliable empirical basis for predicting the likely course of telecom competition in other countries. Starting with the FCC's first significant competitive initiatives in the late 1950's, the U.S. has enjoyed more than three decades of experience with multiple entry and competitive carriers in numerous telecom markets. While several countries are now moving to outdistance the U.S. in market liberalization, the U.S. experience still constitutes the largest database on telecom competition today.

Of course, indigenous factors will play an important role in shaping competitive forces within any particular country. Nevertheless, within the context of those factors, the process of competition can be expected to operate similarly in a given industry structure from one country to another. By understanding how the process of competition has worked in practice in the U.S., policy-makers in other countries can be better prepared to address the difficult tasks that confront them and telecom entities can be better prepared to adopt timely marketplace and regulatory strategies and to counter those of their existing or potential competitors. This paper addresses selected elements of competition in the U.S. interexchange industry which may help predict the development of a competitive interexchange market in other nations.

III. PRICING AND COST ALLOCATION

As the monopoly interexchange carrier prior to competitive new entry, AT&T historically funded its telephone network infrastructure primarily from charges imposed upon high-volume users (e.g., large business users). It is a salient feature of competitive entry in the interexchange switched voice market in the U.S. that AT&T now funds its network infrastructure primarily through the rates charged to low-volume users (e.g., residential users). By contrast, large users receive special service packages and other discounts priced near marginal costs which result in significantly lower contributions than in the past to AT&T's network costs.

This change stems from the comparative impact of a competitive marketplace upon low-volume users and high-volume users. A low-volume user is less likely to change carriers when its existing carrier raises rates (or when a rival carrier lowers rates), a trait which economists call inelastic demand. Such users may lack the sophistication, the knowledge and the motivation to respond to small rate changes by switching carriers. By contrast, a high-volume user is much more likely to select and change carriers based upon price differentials, a trait which economists call elastic demand. Such users often conduct a formal or informal competitive bidding process before selecting a carrier. The result is that competitive market forces, unchecked by regulation, will lead carriers to charge higher rates when relatively inelastic demand is involved, while charging lower rates when relatively elastic demand is involved. Over time, the low-volume user becomes the primary source of funds for interexchange network infrastructure.

Significantly, traditional concepts of public utility regulation in the U.S. do not permit carriers to charge rates based upon the comparative elasticity of demand. Instead, traditional rate base regulation required carriers to calculate the cost of providing individual services and then to derive rates from such costs which will achieve the established rate of return. Historically, carriers were required to allocate to a particular service those marginal costs which were directly attributable to the service as well as a specified portion of joint costs (i.e., costs incurred to provide more than one service). The aggregate costs for a service were the basis upon which the rates for the service were derived.

Historically, the most troublesome part of this rate base process was the allocation of joint costs among different services. After lengthy proceedings, the FCC in 1976 decided to retain the Fully Distributed Costing ("FDC") method for allocating joint costs among individual services, a method supported by newer entrants into the market. Under FDC, AT&T's joint costs were to be allocated among its services based upon measures of comparative usage. The FCC adopted the FDC method over AT&T's strong protest, but AT&T's opposition ultimately prevented the FCC from writing an acceptable cost allocation manual based upon the FDC method.

Beginning in 1984, the FCC replaced the FDC method with the Long Run Incremental Costing ("LRIC") method favored by AT&T. Under the LRIC method, AT&T is required to allocate to a particular service only those costs directly attributable to the service. Those costs are defined as the difference between the total costs incurred by AT&T if the service is offered and the total costs incurred by AT&T if the service is not offered. Under LRIC, AT&T has discretion to allocate joint costs among its various services so long as each service produces positive net revenues for AT&T. Although the FCC never formally adopted the LRIC method for AT&T, the FCC permitted AT&T to justify a wide range of tariffed services in the 1980s by reference to the LRIC method.

The FCC's decision to reject the FDC method and to adopt the LRIC method may have been AT&T's single most important regulatory success in the 1980s. The reason is that only the LRIC method permits AT&T to price its services based on the comparative elasticity of demand. AT&T may charge relatively higher rates to residential users by implicitly allocating substantial common costs to those services, and AT&T may charge relatively lower rates to high-volume business users by implicitly allocating few common costs to those services. In contrast, the FDC method did not permit AT&T such flexibility because it forced AT&T to allocate a specified portion of joint costs to individual services.

After gaining approval of the LRIC method, AT&T began to offer numerous services and service packages with special discounts to large customers. Some of AT&T's staple services for large users, such as Software Defined Network services, are offered at rates which might not be justified under the FDC method. In addition, AT&T has filed over 80 single-customer service packages under Tariff 12, representing almost $2 billion in annual revenues, as well as a number of single-customer rate discounts under Tariff 15 (which the FCC currently permits to take effect after a five-month delay). AT&T's single-customer offerings under Tariff 12 and Tariff 15 represent the culmination of a trend under the LRIC method for more narrowly defined service offerings reaching smaller and smaller user populations. The LRIC method has enabled AT&T to offer the services and service packages necessary to maintain its interexchange market position against aggressive competition from MCI, US Sprint, and other new entrants.

Any nation which utilizes traditional rate base regulation of telecom carriers should expect to face similar cost allocation policy issues once competitive entry is permitted. In particular, regulatory authorities must be prepared to face efforts by all carriers to shift the cost of funding their network from elastic revenues (e.g., business users) to inelastic revenues (e.g., residential users). Certainly, in nations where the monopoly carrier is regulated by a version of the FDC method or otherwise does not price its services based upon comparative demand elasticity, new entrants can be expected to target their initial service offerings at those market segments where demand elasticity is highest. In the U.S., AT&T's private line services were an attractive target for MCI and other new entrants beginning in the late 1960s. The FCC's cost allocation proceedings, as well as the studies prepared by outside parties and academic writing in the U.S., constitute a large database for any other nation which may confront cost allocation issues.

In the regulatory arena, new entrants can be expected to try to force the pre-existing carrier to adhere to a version of the FDC method, arguing that the FDC method is necessary to prevent the carrier from engaging in unfair cross-subsidization and predatory pricing. The pre-existing carrier will support a version of the LRIC method, arguing that the FDC method is economically arbitrary and forces the carrier to maintain an anti-competitive and inefficient pricing umbrella for the sole benefit of its competitors. The regulatory authorities must decide which method best promotes fair competition under a particular set of industry circumstances, a decision which has changed over time in the U.S. Such decisions are particularly difficult because they will have a direct and often substantial impact upon the market share of competing carriers, a unaccustomed role with which regulatory authorities may be uncomfortable.

Regulatory authorities may consider whether to discard rate base regulation in favor of a system of incentive regulation known as price caps. The Office of Telecommunications ("OfTel") in the U.K. pioneered price caps regulation, and the FCC in April 1989 adopted a price caps system of regulation for many of AT&T's services. In October 1990 the FCC adopted a more complex version of price caps regulation for certain local exchange carriers ("LECs"). Under price caps, AT&T is required to place certain services into one of three baskets (residential and small business; 800 service; and other business services). AT&T's rates for an individual service will be presumed lawful so long as they satisfy specified upper and lower limits (typically, five percent annually) and the overall price cap for the entire basket is met. For those services governed by price caps, the FCC no longer applies a cost allocation method when reviewing AT&T's tariff filings.

Price caps regulation has not put to rest the underlying cost allocation policy issues. Many of AT&T's services with rates based upon the LRIC method are not governed by price caps. Even for services subject to price caps, the starting point is AT&T's existing rate structure, which in many cases already reflects the LRIC method. Even if the current rate structure did not reflect the LRIC method, price caps regulation may provide the carrier with sufficient flexibility to engage in LRIC pricing on a prospective basis. While price caps regulation has removed cost allocation from the review of tariff filings by the FCC, it has not superseded the underlying cost allocation issues and it does not appear to be competitively neutral towards the cost allocation method which AT&T actually uses to derive rates.

IV. RESALE AND EQUAL ACCESS

Two key elements of the FCC's policy of promoting interexchange competition have been: (1) prohibiting any restrictions by facilities-based carriers upon the resale or sharing of their services; and (2) requiring LECs to give new facilities-based entrants equal access to the local exchange. The resale policy ensures that new entrants are able to provide service even before they have built their own facilities. That policy also enables new entrants to discipline the rate structures of facilities-based carriers and to occupy niche markets profitably. The equal access policy is designed to permit new entrants to interconnect their facilities with the local exchange network on equivalent terms, conditions and rates as the existing carriers, a critical pre-condition for multiple entry.

The FCC's resale policy, applicable solely to domestic services, has proved simple and relatively effective. The foundation of an effective resale policy is that dominant carriers file tariffs containing all the terms, conditions and rates of service and that regulatory authorities have adequate enforcement mechanisms. In the U.S., AT&T still must file tariffs and the FCC's tariff review and formal complaint procedures provide necessary enforcement capabilities. To date, the FCC has not required carriers (other than cellular radio carriers) to offer special wholesale or non-retail rates to resellers. The FCC's resale policy proved singularly successful through the late 1970s and mid 1980s. However, the policy's efficacy was drawn into question in the late 1980's due to AT&T's single-customer offerings, which the FCC permitted in the name of full competition but which have been alleged to inhibit or preclude meaningful resale by third parties.

Equal access proved more difficult to implement. When competitive entry first occurred, the new entrants received technically inferior access to the local exchange network under Feature Group A and B, while AT&T received superior access through Feature Group C. For many years, subscribers were required to dial numerous digits in order to reach the facilities of a new entrant, while a subscriber could reach AT&T simply by dialing "1" plus the 10-digit number to be called. Transmission quality for new entrants also was inferior. The FCC sought to compensate for this inferiority by requiring new entrants to pay only a portion of the charges paid by AT&T for access to the local network.

It was the District Court supervising the AT&T divestiture, not the FCC, that in 1984 ordered this technical inferiority to be corrected through equal access. The District Court's order applied only to the former Bell Operating Companies ("BOCs"), which were required to provide new entrants with access that is "equal in type, quality and price" to the access furnished to AT&T. The BOCs installed equal access facilities -- known as Feature Group D -- for carriers other than AT&T according to specific timetables. The District Court also required the GTE companies to furnish equal access, and the FCC imposed a similar requirement upon independent local carriers under certain conditions in 1985. Recent data indicate that the BOCs will have converted 97% of all end offices to equal access by the end of 1990.

Equal access has permitted all customers to reach the carrier of their choice, not just AT&T, by dialing "1" plus the 10-digit number to be called. In order to determine each subscriber's preferred carrier, the FCC has established ground rules for, and actively supervised, a "presubscription" process whereby the local carriers send information and ballots to subscribers. Subscribers select their preferred carrier through the ballot or by direct authorization to the carrier. Subscribers who do not select a carrier are randomly assigned to a carrier based upon each carrier's percentage share of voting subscribers.

Other nations can expect to confront similar types of issues in implementing equal access. The resolution of those issues can be expected to cost substantial time and money, both for regulatory authorities and telecom carriers. The local exchange carrier may have economic incentives to make the fewest and least expensive network changes over the longest period of time. The new entrants may desire perfectly equal access, no matter how difficult or expensive, over the shortest possible time frame. Due to these conflicting interests, the regulatory authorities could face numerous complaints requiring active supervision and mediation of both a technical and a policy nature over many years. The effective resolution of such complaints may prove crucial to the development of lasting competitive market structures, as the equal access process in the U.S. was a catalyst for the growth of AT&T's rivals in the mid and late 1980s.

An important decision will be whether to allocate a single carrier to each subscriber line for all domestic and international calling, or whether to permit subscribers to choose their international carrier separately from their domestic carrier. The U.S. uses the former approach, while the Japanese implement a version of the latter approach, requiring subscribers to select an international carrier on a call-by-call basis by dialing a three-digit access code. A disadvantage of the U.S. presubscription approach is that it introduces an added degree of demand inelasticity to international services. A disadvantage of the Japanese approach is that it magnifies the market impact of decisions by regulators on the comparative degree of pricing flexibility to be given to competing carriers.

Based on the U.S. experience, especially close regulatory supervision may be required when the same company provides both local exchange and interexchange service (either through separate divisions or affiliates). That situation poses the danger that the carrier will seek to skew the equal access process to favor its own interexchange operations. Earlier this year the U.S. encountered serious allegations of repeated discrimination and favoritism in the equal access process in Puerto Rico, where the LEC has an affiliated interexchange carrier.

The U.S. is still confronting significant equal access issues on an on-going basis. The equal access process for BOC pay telephones was only recently completed. More currently, there have been serious accusations that interexchange carriers are stealing thousands of each other's customers through phony carrier change authorizations, a process known as "slamming." An important issue which may arise next year is whether carriers should receive volume discounts for access charges, which are currently prohibited by the AT&T divestiture decree through September, 1991.

V. NETWORK INFRASTRUCTURE

Equal access addresses only one of the network inequalities which may favor an existing carrier over new entrants in a competitive market.

Other network and traffic configurations may also affect competitive market conditions. Existing carriers can be expected to take full advantage of these benefits in newly competitive markets. Even where competition has not yet been introduced, an existing carrier might seek to incorporate these advantages into the network today in anticipation of limited or unrestricted competitive entry sometime in the near future. New entrants may need to explore regulatory or legislative solutions to these problems, and Government officials should be aware from the start of the substantial competitive advantages and disadvantages which can result for different carriers from the network infrastructure.

In the U.S., AT&T enjoys several cost advantages due to its status as the former monopoly carrier. AT&T's higher traffic volume (as much as 70% of the domestic market) translates into substantial cost savings through economies of scale. AT&T also has more network nodes located at shorter distances to LEC switching facilities than any other carrier. This network configuration, which is a byproduct of AT&T's role as the former monopoly carrier in the U.S., reduces AT&T's cost of obtaining access to the local exchange, which constitutes approximately 50% of AT&T's total service costs. Smaller U.S. carriers have fewer nodes located at greater distances from LEC switching facilities. Those carriers have estimated that they must pay local exchange carriers for 100% more switched access miles and 73% more voice grade special access miles than AT&T for the same traffic, a disparity which imposes cost penalties upon smaller carriers given distance-sensitive LEC access charges. These cost differences can prove significant in a competitive market.

AT&T also enjoys ubiquitous out-of-band signalling through its CCIS-6 System, while other carriers depend upon new LEC facilities, which are under construction according to variable timetables, to deploy fully their own out-of-band signalling system (Signalling System 7). AT&T is the only carrier which can offer subscribers a portable 800 number (i.e., an 800 number which the subscriber can use for any carrier). AT&T is the only carrier with access to the billing and collection capabilities, as well as calling card validation data, of virtually all LECs in the U.S., giving AT&T substantial cost and operational advantages in the growing operator services and transient calling markets. Advantages such as these can play a particularly important role in a mature competitive entry environment.

The most aggressive and successful carriers are those able to install nation-wide networks in an equal access environment with a minimum of dependence upon the resale of an existing carrier's facilities. It is no fluke that the three major carriers in the U.S. -- AT&T, MCI and US Sprint -- are the only carriers with their own ubiquitous networks serving all classes of users. Through these networks, all three carriers have a substantial base of inelastic revenues (e.g., residential users) from which to fund their networks and to compete on the basis of marginal costing for the business of the largest subscribers. Absent unique cost advantages, it will be difficult for any carrier to expand beyond a niche market without a similar network infrastructure.

It should be noted that new entrants may have certain cost advantages of their own. Often, the previous monopoly carrier is required to provide certain services at no profit, or even at a loss, as a public good. New entrants typically are freed of such costly obligations as they pursue a more selective clientele. In addition, the previous monopoly carrier may delay before adopting the cost reductions and resource re-allocations necessary to compete most effectively. New entrants are more likely to streamline their operations from the start. In the U.S., AT&T did not begin to stop its market share decline until it reduced its work force by tens of thousands of employees after divestiture in the mid-1980s. The interexchange industry has continued in a spiral of cost reductions in 1990, with AT&T, MCI and US Sprint instituting still further payroll cuts in an effort to control costs.

Another significant factor in the development of competition will be the extent to which the pre-existing carrier develops a pro-active stance rather than simply reacting to marketplace developments initiated by rivals. In the early 1980s, AT&T permitted its major rivals to seize market share through more aggressive service development and marketing. By the mid to late 1980s, AT&T showed more initiative in introducing its own new products and services, as well as marketing more aggressively against its major rivals. In particular, AT&T sought to offer a full range of services and equipment to its customers, an approach known as "one stop shopping." By posturing itself as a total systems integrator, AT&T is seeking to move competition to a level where AT&T is best able to translate its corporate advantages into competitive success. The U.S. experience demonstrates that a carrier will enjoy more success when it shows initiative in introducing new products and services and making infrastructure investments, rather than waiting to react to such moves by other carriers.

Based on the U.S. experience, there is no substitute in a fully competitive environment for building a state-of-the-art network and then making the continuing investments necessary for the development and roll-out of new services and capabilities as technology permits. Carriers which fall behind in network infrastructure sooner or later will fall behind as competitors. Consequently, the availability of capital to finance such infrastructure improvements may become an important competitive factor. Both carriers and regulators alike must be alert to the ways in which network and traffic factors can confer advantages or disadvantages in a competitive market.

VI. REGULATORY ALTERNATIVES

Based on the U.S. experience, it is inevitable that telecom carriers will develop regulatory strategies hand-in-hand with their business strategies. Companies which desire to become new entrants, or to expand into previously monopoly telecom service niches, will seek the complete removal of all regulatory and legal barriers to competitive entry as soon as possible. They also may seek to retain full or even expanded regulation of the previous monopoly carrier, while protecting their own freedom to operate in a competitive entry environment without burdensome regulations. As two examples, new carriers may seek to have regulators apply some version of the FDC method to control the pre-existing carrier's cost allocation and pricing practices (see supra Section I) and have regulators require the carrier to operate certain business segments through structurally separate companies with rigorous accounting safeguards. The avowed purpose of this strategy will be to protect nascent competition from being suffocated at the hands of the previous monopoly carrier.

The monopoly carrier will devise a counter-strategy of its own. Initially, the carrier may try to delay competition as long as possible and, when competition can be blocked no longer, the carrier will seek to limit competition to discrete market segments. Once significant competitive entry is permitted, the previous monopoly carrier will try to preserve its ability to compete freely against all new entrants in the marketplace. Using the previous two examples, the carrier will seek to have a version of the LRIC method used for cost allocation, and it will seek to have no greater structural separation or accounting requirements imposed upon itself than the regulators impose upon other rivals. The avowed purpose of this strategy will be to ensure that regulators do not defeat real competition by giving new entrants a "free ride" through service and pricing regulations which do not apply equally to all carriers.

A cross-roads decision for regulatory authorities in any nation will be whether to impose tougher restrictions upon the previous monopoly carrier than upon new entrants. The FCC implemented such a policy in the late 1970s and early 1980s in the so-called Competitive Carrier proceedings. New entrants were almost completely deregulated by the FCC on the theory that their lack of market power reduced or eliminated the need for regulatory oversight. The FCC continued to require AT&T to adhere to traditional requirements, such as the filing of tariffs and cost support materials, on the theory that such regulatory oversight was necessary to protect emerging competitive forces against AT&T's market power. By the mid-1980s, the FCC began to relax significantly its oversight of AT&T's tariff filings and pricing practices based on the FCC's perception that competition was thriving. By April, 1990, the FCC proposed to begin introducing virtually complete deregulation for certain AT&T services, a proceeding which is still pending at the FCC.

The FCC's competitive policies have swung like a pendulum. In the early 1980s, the FCC's principal concern was that unregulated competition would permit AT&T to thwart the long-term development of a competitive market. So the FCC permitted new entrants more regulatory freedom than AT&T. By the mid-1980s, the FCC's primary concern was that its system of "asymmetrical regulation" defeated the real purpose of a competitive market by forcing AT&T to act as an umbrella to protect its rivals from the need to compete based upon the merits of their own products and services. The numerous proceedings conducted by the FCC throughout this process, as well as the studies prepared by economists and other consultants to the carriers, constitute a significant database for carriers and government authorities in other nations regarding the best regulation of the transition from telecom monopoly to competitive entry.

From the beginning, the FCC believed that telecom competition would be a substitute for traditional regulation and ultimately reduce the administrative cost of industry oversight. In practice, the transition from monopoly to competition has required at least as many FCC resources as traditional monopoly regulation. The FCC's system of "asymmetrical regulation" stemmed in part from the logistical impossibility of subjecting all carriers in a multiple entry environment to traditional regulation. Similarly, one of the principal benefits of price caps regulation is that it reduces Government costs by relying upon mathematical formulae to oversee the industry. However, it is still an unanswered question in the U.S. whether such formulae can deliver to the public the full benefit of telecom competition.

Each nation must search for its own answer to the difficult question of reconciling competitive entry with the public interest. The U.K. experimented with a duopoly policy, which it now may replace with some version of a multiple entry policy. Australia appears inclined to replicate the U.K. duopoly policy. In Japan, the establishment of three international carriers has resulted in robust competition after only one year, leading an IIC report to claim that the Japanese international telecom market is the most competitive in the world today. The U.S. multiple entry model has achieved a market structure similar to that devised by the Japanese, as the U.S. international services market (as well as the domestic services market) is dominated today by three carriers. In every case, the challenge will be for the regulatory authorities to adopt the measures necessary for full competition without supplanting competition with regulatory micro-management.

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Telecommunications Terminal Equipment Compliance Approvals Under the New System for the Past Five Years

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1. ABSTRACT

The principle of competition was introduced to all fields of telecommunications in Japan in April 1985. This included dramatic relaxation of the regulations governing telecommunications terminals, and a new compliance approval system was put in force.

The Japan Approvals Institute for Telecommunications Equipment (JATE), a governmental sanctioned, non-profit organization, was established in March 1984, just before liberalization of Japan's telecommunications market. It was designated by the Minister of Posts and Telecommunications as the institution for approval of telecommunications terminal equipment in accordance with the Telecommunications Business Law, and began providing service in April 1985. Since then, JATE has been providing fair, impartial and speedy service. As of March 1990, it had examined 8543 applications for approval, processing each of them in less than two months.

This report analyzes the five years achievement of the new approval system, which for the first time introduced the principle of "Self Declaration". The report will show how the system has activated the terminal equipment market, inspired the entry of various section of domestic and oversea industries into the market, and significantly contributed to the further development of telecommunications industries and services.

2. CHARACTERISTICS OF THE COMPLIANCE APPROVAL SYSTEM FOR TERMINAL EQUIPMENT IN JAPAN

The system in force in Japan has the following characteristics:

2.1 TECHNICAL STANDARDS AND REQUIREMENTS

In Japan, as in most other countries, connection of terminal equipment with public networks requires compliance with certain technical standards. These standards consist of two types, Technical Standards and Technical Requirements. Technical Standards are ministerial ordinances enacted by the Ministry of Posts and Telecommunications, while Technical Requirements are set forth by Type I telecommunications carriers with the approval of the Minister of Posts and Telecommunications. Technical Standards are further broken down into general standards that apply to all terminal equipment, and specific standards that apply only to terminal equipment that is to be connected to the public switched telephone network (hereafter referred to as PSTN terminals). Technical Requirements specify particular conditions for terminals to be connected to networks other than the public switched telephone network (hereafter referre to as non-PSTN terminals), such as leased lines and ISDN.

Both the Technical Standards and the Technical Requirements are primarily based on "No harm to the network" including.

- Protection of the network from damage or disorder.
- Prevention of interference with other users.
- Demarcation of responsibility.

Excluding norms on the quality or performance of the equipment concerned.

When the first Technical Requirements were set up in April 1985, there were ten requirements covering two telecommunications carriers (NTT and KDD). Due to the successive entry of other carriers, however, that had grown to 58 requirements covering 28 carriers by the end of September 1990. All approvals for compliance with these technical standards and technical requirements are granted by JATE.

2.2 COMPLIANCE APPROVAL AND INSPECTION BY TYPE I TELECOMMUNICATIONS CARRIERS

Since granting of compliance approval guarantees that the terminal equipment can be connected to the public network, an equipment that has not received such approval must be submitted for inspection by a carrier to certify its compliance with appropriate Technical Standards or Technical Requirements before that equipment can be used.

Thus, users of such equipment can choose either approach for connection of them. However, inspection by a carrier requires application by each individual user. Therefore, it is usually carried out only for connection of trial products or a small number of items for special purposes. Suppliers of equipment for the general market normally receive compliance approval before placing their equipment on sale.

2.3 COMPLIANCE APPROVAL BASED ON "SELF DECLARATION"

Compliance approval based largely on "Self Declaration" is, in principle, an examination of the documentation provided and not on actual products. The testing data supplied in this way can be based on results obtained by the applicant, or by an institute elected by the applicant. If the testing method described in the application is considered appropriate,the data will be accepted from any source, including overseas institutions. JATE does not designate specific institutions for testing, and no conditions or qualification are placed on the applicant.

3. INCREASE IN NUMBER OF APPROVALS

3.1 OUTLOOK

Figure 1 shows the trend in number of approvals and number of applicants for the five years preceding and after reformation of the system, while Table 1 compares the different types of equipment by number of approvals and number of applicants. The number of approvals increased sharply after FY 1985, as did the number of applicants, but there was also a significant increase in the number of approvals granted in FY 1984 in anticipation of reformation of the system. This tendency was strengthened by such factors as simplification of Technical Standards in July 1985, with the number of approvals continuing to increase rapidly until FY 1986, when the new system was set up. Change after that maintained a steady 2 to 3% increase until FY 1988, when the start of ISDN service (April 1988) promoted a larger increase.

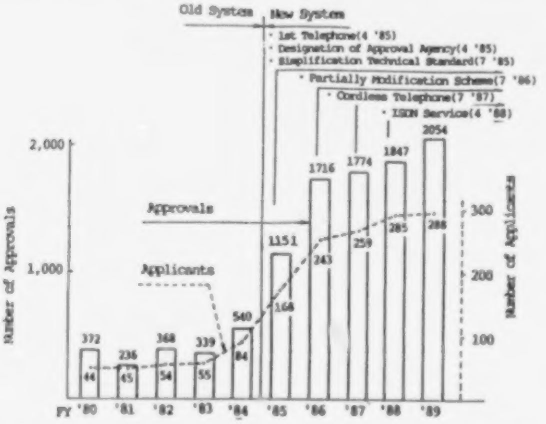

Figure 1 Trend in Number of Approvals and Applicants

Table 1 The Comparison of Number of Approvals and Applicants for Each 5 Years in New and Old System

	OLD SYSTEM FY '80 ~ FY '84		NEW SYSTEM FY '85 ~ FY '89		Proportion (times)	
	Number of Approvals	Number of Applicants	Number of Approvals	Number of Applicants	Number of Approvals	Number of Applicants
PSTN Terminals	1,658	96	6,083	547	3.7	5.7
Telephone Sets	292	42	1,086	131	3.7	3.1
PBXs	42	16	353	30	8.4	1.9
Key Telephone Systems	428	23	747	63	1.8	2.7
Facsimile Machines	512	23	782	33	1.5	1.4
Modems	97	25	956	170	9.9	6.8
Others	287	51	2,159	340	7.5	6.7
Non-PSTN Terminals	197	53	2,459	207	12.5	3.9
Total	1,855	123	8,542	625	4.6	5.1

(Note)
Terminal equipment complied with both technical standards and requirements refer to PSTN and non-PSTN are classified to PSTN terminals.

The number of approvals for the five-year period since introduction of the new system is 8542, while that for the number of applicants is 625. This represents 4.6-fold and 5.1-fold increases, respectively, from the totals for the last five years under the old system. So far, only one item has failed to receive compliance approval under the new system.

3.2 NUMBER OF APPROVALS FOR EACH TYPE OF EQUIPMENT.

(1) TELEPHONE SETS

Figure 2 shows the trend in number of approvals and number of applicants for telephone sets. As shown in that figure, the number of approvals increased rapidly after reformation of the system. This was due to expected high demand for telephone sets brought about by liberalization of the first telephone. The telephone market was the first to see such action. The number of approvals reached a peak in FY 1987 due to liberalization of the cordless telephone market in October 1987, but has decreased since then. There seem to be two reasons for this:

1) Weak competitors are being forced to withdraw from the market.
2) A shift in user needs. Part of the demand for telephones is being replaced by demand for home telephones (single-line key telephones for home use).

On the other hand, the number of approvals for cordless telephones has continued to increase steadily, accounting for 30% of all telephones granted compliance approval in FY 1989.

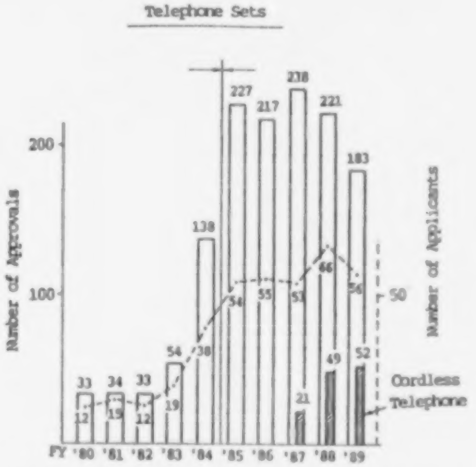

Figure 2 Trend in Number of Approvals and Applicants for Telephone Sets

(2) PBXs AND KEY TELEPHONE SYSTEMS

Figure 3 shows the trend in number of approvals and number of applicants for PBXs, while Figure 4 shows the same for key telephone systems.
The significant increase in number of approvals for PBXs is due primarily to two factors:

1) The new system applies to large-capacity PBXs rather than requiring them to be submitted for individual examination, which was the case under the old system.
2) There has been marked development of digital PBXs for use in LANs and WANs.

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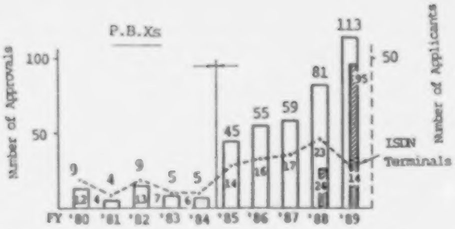

Figure 3 Trend in Number of Approvals and
Applicants for PBXs

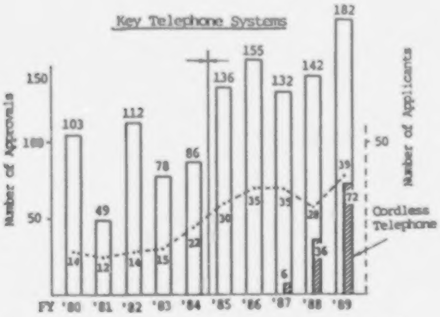

Figure 4 Trend in Number of Approvals and
Applicants for Key Telephone Systems

In addition, there has been an increase in number of approvals since the start of ISDN service in 1988 due to the number of applications for digital PBXs that provide ISDN functions. The number of new applications, however, is rather limited, so the increase is not as prominent as the number of approvals.

The number of approvals for key telephone systems did not increase significantly due to the large number of approvals under the old system. Nevertheless, the rate of increase in number of new applicants is striking, which indicates severe competition in this field, particularly for single line systems which have cordless extension telephones for home use.

(3) FACSIMILE MACHINES

The trend in number of approvals and number of applicants for facsimile machines is shown in Figure 5. As shown in that figure, the change induced by introduction of the new system has not been remarkable. This is due to the fact that there were a considerable number of approvals granted under the old system. In addition, the limited number of new applicants in this field also keeps the increase in number of approvals small.

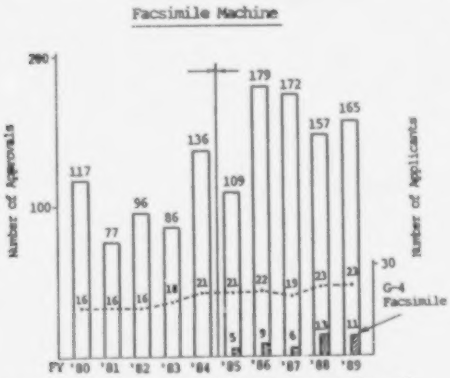

Figure 5 Trend in Number of Approvals and
Applicants for Facsimile Machines

(4) MODEMS

Figure 6 shows the trend in number of approvals and number of applicants for modems. As shown in that figure, the number of approvals for these devices has risen sharply since the start of the new system. This is probably due to the fact that there is still strong demand for data communication utilizing PSTN, sparked by popularization of office automation and personal computer communication. Although the number of approvals seems to have been near the point of saturation since FY 1986, the number of card modems for personal computers and word processors has managed to increase. Most approvals now seem to be for high-speed devices.

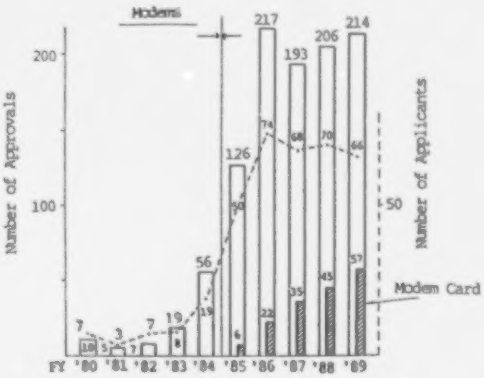

Figure 6 Trend in Number of Approvals and
Applicants for Modems

(5) OTHER PSTN TERMINALS

The number of approvals and the number of applicants for other PSTN terminals are shown in Figure 7. This is the category that has shown the

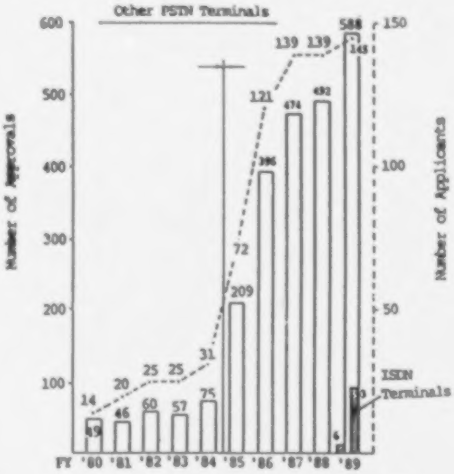

Figure 7 Trend in Number of Approvals and
Applicants for Other PSTN Terminals

greatest increase since the start of the new system. The majority of items are data terminal equipment and various kind of equipment for monitoring and control systems, but there are also voice mail systems and an equipment that provides ID number functions.

The rate of increase in number of applicants is also highest for this category because most of the items approved are for specific applications; relatively a few of them are for general use.

(6) NON-PSTN TERMINALS

Non-PSTN terminals are network terminals used with other than the PSTN. They are submitted for approval of compliance with Technical Requirements and include leased-line terminals; ISDN, DDX(Digital Data Exchange)and TLX equipment; acoustic couplers. The trend in number of approvals for these terminals is shown in Figure 8.

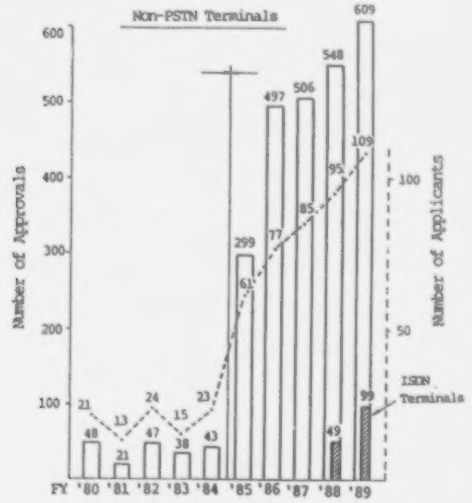

Figure 8 Trend in Number of Approvals and Applicants for Non-PSTN Terminals

There are several reasons why the number of approvals for these types of equipment has increased since the start of the new system. The new system applies to leased-line coded terminals and DDX terminals, greater part of which under the old system had to be submitted for individual examination. There is also increased usage of digital communication, and new carriers are entering the telecommunication market. There is also the start of new services, such as ISDN.

Although the majority of equipment approved under the old system was leased-line terminals and acoustic couplers, in recent years, DDX and ISDN terminals, and leased-line coded terminals have accounted for 70% of all non-PSTN terminal approvals.

3.3 NUMBER OF APPROVALS FOR FOREIGN EQUIPMENT

Table 2 shows the trend in number of approvals granted by country of origin. As shown in that table, the number of approvals for foreign equipment has increased steadily. The total number of approvals for foreign equipment over the past five years reached 995 (11.6% of the total of 8542 items approved). That is 21.2 times the number (47) for the last five years under the old system.

A total of 332 items of voice-type equipment has been approved, 84% of which have come from Asia and the United States. There have also been 663 non-voice-type items approved, 89% of them from the United States.

Figure 9 classifies the number of approvals by type of equipment. These items can be classified into three roughly equal groups: Voice type equipment, Data terminals, and others.

Table 2 Number of Approvals for Foreign Equipment

FY / Country	1985		1986		1987		1988		1989		Total	
U.S.A.	7	98	16	97	11	101	13	129	5	162	52	587
Canada	2		3		3			2	4	5	12	7
China							1				1	
Taiwan	35	1	32	10	38	4	37	7	23	5	165	27
Hong Kong	11	1	4		4	1	1		5	1	25	3
Korea	1		1		4		16	4	12	1	34	5
Singapore	1		1	1							2	1
Malaysia									1		1	
Australia			1			3	1				2	3
U.K.	4			7		2	2	6	4	2	10	17
Italy	13						1				14	
W.Germany			1		4		3				8	
Finland		2		2						3		
Sweden			1	1			1				2	1
France								3		1		4
Switzerland			1						2	1	3	1
Denmark									1		1	
	74	102	61	118	64	111	76	151	57	181	332	663
Total	176		179		175		227		238		995	
Number of Approvals	1151		1716		1774		1847		2054		8542	
Percentage (%)	15.3		10.4		9.9		12.3		11.2		11.6	

(Note)
The figure of each box separated left and right part show the number of approvals for voice type terminals, non-voice type terminals.

(Note) Foreign equipment
In addition, to applications received from overseas, this category includes applications from foreign affiliates of Japanese companies (excluding OEM supply by domestic companies) and Japanese companies applying for approval of equipment received from overseas suppliers (trading companies, manufacturers, etc.). It does not include equipment manufactured by Japanese companies overseas.

4. EXPANTION OF RANGE IN APPLICANTS

Table 3 shows the trend in average number of approvals per applicant per year, while Figure 10 shows the distribution of applicants classified according to the number of approvals granted for each in FY 1985, FY 1987 and FY 1989. As shown in Table 3, the average number of approvals per applicant was nearly-constant 7 in each of those fiscal years. However, as shown in Figure 10, there is a tendency towards polarization, with a significant increase in the number of applicants receiving only 1 or 2 approvals per year, as well

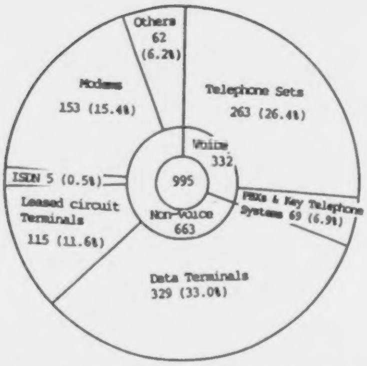

Figure 9 Approvals of Foreign Equipment by Type

Table 3 Average Number of Approvals Per Applicants

	Number of Approvals	Number of Applicants	Average Number of Approvals /Applicant
FY '85	1151	168	6.9
'86	1716(1.49)	243 (1.45)	7.1
'87	1774(1.03)	259 (1.06)	6.8
'88	1847(1.04)	285 (1.10)	6.5
'89	2054(1.11)	288 (1.01)	7.1

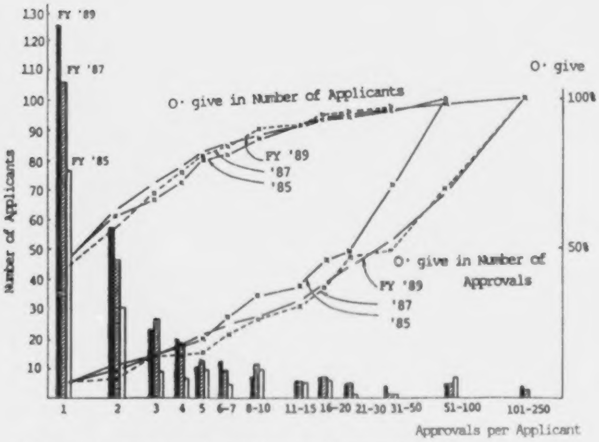

Figure 10 Number of Applicants/Approvals per Applicant

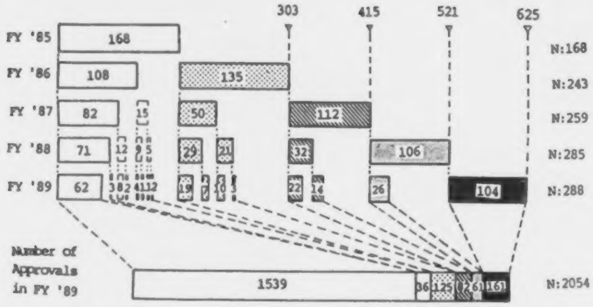

Figure 11 Trend in Number of Applicants

as in the number of applicants receiving more than 100 approvals per year. Although there has been a slight increase in the rate of increase for those receiving several approvals per year, half of all approvals are granted to the 10 highest ranking companies each fiscal year.

Figure 11 lists the number of applicants for each fiscal year classified according to whether or not they submitted applications in previous fiscal years. As shown in that table, the number of applicants who had not previously submitted an application (i.e., new applicants) has decreased from a high of 168 in FY 1985 to 104 in FY 1989. However, since applicants in FY 1985 and FY 1986 include those who had previously applied under the old system, it can be said that there are roughly 100 new applicants each year. However, for the four-year period from FY 1985 through FY 1988, 245 of those new applicants only submitted one application. That is almost half of the 521 new applicants during that period.

There are 62 applicants who have submitted applications in each of the past five years. As of FY 1989, they account for 22% of the 288 applicants, and received 1539 (75%) of the 2054 approvals granted. The average number of approvals for new applicants in FY 1989 is 1.5.

Figure 12 classifies new applicants by type of industry for each fiscal year. As shown in that figure, the rate of industries other than electronic and telecommunications equipment manufacturing has been increasing year by year, which indicates successive entry of a wide range of industries into the terminal market, in company with the ever expanding use of telecommunications.

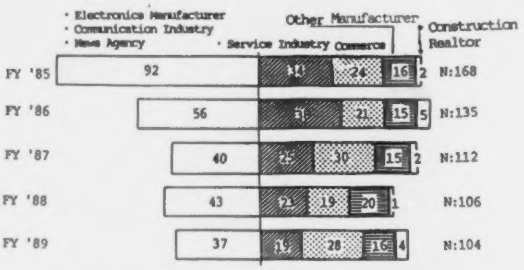

Figure 12 New Applicants by Type of Industory

In summary, on the one hand, most approvals are still being granted to traditional telecommunication manufacturers, especially several large enterprises. On the other hand, there has been a succession of entries by other types of manufacturers into the terminal market, many of whom only submit one or two applications per year. The change in new entries is significant in this range.

By type of equipment submitted for approval, the greatest turnover in applicants is for telephone sets, other PSTN terminals and non-PSTN terminals, with few changes in applicants for PBXs and facsimile equipment.

5. "PARTIAL MODIFICATION" SCHEME

A "Partial Modification" scheme under which approval is granted at reduced charge for partial

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modification of approved equipment that do not significantly affect the structure or functions of the equipment was initiated in July 1986. The number of approvals granted under this scheme has increased 7.1% in FY 1986 to 15.6% in FY 1989.

6. NUMBER OF DAYS REQUIRED FOR EXAMINATION

Table 4 lists the number of days required for examination, which is the interval from acceptance of an application to final decision of approval. Of all applications received over the past five years, 50% were granted approval within 24 days, 90% within 39.9 days, and all within 60 days. The average number of days required for examination was 26.2. By type of equipment, the average number of days required ranged from a rather short 22.6 days for telephone sets to a relatively longer 28.5 days for PBXs and key telephones.

Table 4 Days Required for Examination(FY '85-'89)

	Days in Average	Days Completed 50% of All	Days Completed 90% of All
Telephone Sets	22.6	20.9	34.1
PBXs & Key Telephone Syss	28.5	26.1	43.8
Other PSTN Terminals	25.9	24.0	38.2
Non-PSTN Terminals	27.1	25.4	41.7
Total	26.2	24.0	39.9

7. RESULTS OBTAINED UNDER THE NEW SYSTEM

Under the current system, it is not illegal to sell non-approved equipment. However, there are few reported cases of such sales in the general market, although such cases did occur under the old system and during transition to the new system.

This is probably due to the fact that, with setting up of the new system, both suppliers and users have come to recognize that the "mark of approval" is a profitable sales point. Another reason could be that the new system has made obtaining compliance approval more transparent and easier.

Competition in the telecommunications market has inspired proliferation of terminal equipment while stabilizing the prices of such equipment at the lower level. Figure 13 and figure 14 show the trends in retail price (price suggested by the manufacturer) for cordless telephones and G-4 facsimile machines as being representative of terminal equipment for home use and business use, respectively. As shown in these figures, in both cases, the trend for the past two years has been an obvious lowering of price.

8. CONCLUSIONS

Our new terminal policies, which are based on minimal regulation and fair competition, have inspired various kinds of enterprises to enter the terminal market, and has prompted a trend toward proliferation. In addition, they helped the growth of application from the enterprises concerned primarily with telecommunications, so that, new policies have activated the terminal market by bring about an increase in the number of terminals approved for technical compliance.

This change has brought terminal users a broad choice of equipment at a lower price. Thus, it is obvious that new policies has supported the proliferation of telecommunications users choice and benefits.

It can be said that the aims of our Telecommunications Business Law, that is, fastening benefit to the nation through fair competition, has gained expected results. It must be noted, in addition,that as creation of utilities and new services of telecommunications depends more and more on the terminals, the new system did and will promote significantly the development of telecommunmications services and industry at large. Although it would not be appropriate to ascribe all of these results to the new approval system, proper operation of that system is significant factor supporting them.

The purpose of this report has been to show that Japan's approval system is moving in the desired direction and with successful result. It is the avowed intention of JATE to continue providing fair and speedy approval service.

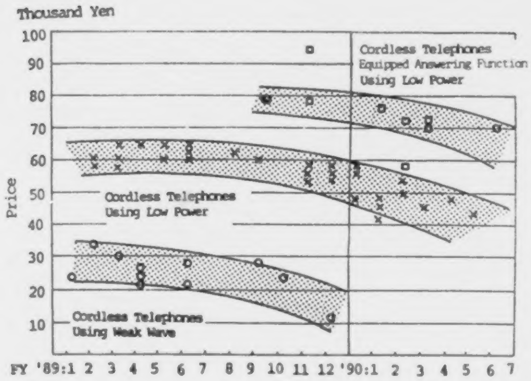

Figure 13 Trend in Price of Cordless Telephones

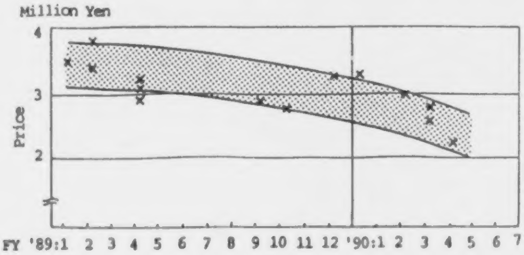

Figure 14 Trend in Price of G-4 Facsimile Machine (Plane Paper Type)

THE CASE FOR THIN-ROUTE, DIGITAL SCPC AS A VIABLE ALTERNATIVE TO SATELLITE VSAT IN DEVELOPING NATIONS: A CASE STUDY IN INDONESIA

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Michael L. Deecke
Advisor, Smartcom Division
PT Elektrindo Nusantara
Jakarta, Indonesia

1. ABSTRACT

This paper highlights the steps leading to the commissioning of a dedicated satellite communications system providing air traffic control at remote airport locations in Indonesia. Presented as a case study, the paper concentrates on the factors key to proving the business case for applying a particular technology to this specific application.

The case study describes the design and installation of a digital SCPC satellite link between an isolated, yet busy airport in West Kalimantan, (Borneo) Indonesia and Cengkareng International Airport, near Jakarta.

INDONESIA : ASIA'S AWAKENING GIANT

INDONESIA'S VAST POTENTIAL :

The Republic of Indonesia consists of more than 13,000 islands spread over 5,000 km East to West and 1700 km North to South. (See Map-Fig 1). Rich in natural resources, Indonesia is an attractive target for industrial investment by developed nations. Over 50 percent of Indonesia's population of 180 million people are under the age of 30, potentially making low-cost labour its most valuable asset.

Straddling the equator, Indonesia has a very benign climate year-around. This non-seasonal tropical environment is attractive to prospective tourists from Northern and Southern Hemispheres. Blessed with political stability and a countless supply of undeveloped "Tropical Island Paradises", it is also rich in those natural resources that have been recently experiencing a rapid increase in demand by North American, European, and Asian tourist markets.

MARKETABLE RESOURCES :

Indonesia's political and monetary infrastructure is sufficiently advanced to make its key natural resources attractive to world markets. These resources are:

- Raw materials, petroleum, minerals, forestry.
- Low-cost labour, manufacturing, agriculture.
- Tourism, hotels and real estate

Being self-sustaining in food, housing, local transportation and medical services, the Indonesia Government is in a position to allocate the bulk of foreign investment towards developments of private industry. Recognizing the need for hard currency exports, Indonesia has used tax incentives to encourage the channelling of foreign investment capital into the three industry groups listed above.

DEVELOPING THE RESOURCES :

The Indonesian Government has been very successful in using foreign capital for the development of these industry groups. External capital flowing into joint-ventures formed between foreign and local corporations has given Indonesia the tools required to process its resources to a marketable form. Foreign participation in joint ventures has resulted in the introduction of oil and gas exploration and production, a variety of mines producing coal, gold, nickel, tin, etc. Manufacturing facilities are increasing rapidly, and many tourist-oriented hotels are being built throughout the archipelago. The abundance of raw materials, availability of low-cost labour, and ideal climate should make Indonesia's products highly competitive in local and world markets. Unfortunately, the Indonesian transportation and communications infrastructure has received less assistance from developed nations.

THE MISSING LINK :

AIR TRANSPORTATION

The geography of Indonesia makes efficient air transportation essential to the success of each of the industry groups.

- Manufacturing operations require immediate delivery of components from domestic and international sources.
- Hotels require consistent, on-time service from domestic and international carriers in order to attract tourists and business investment.
- Resource-based companies operating in remote areas require logistic and personnel communications links.

The frequency of scheduled air service at airports serving more remote centers may range from twice weekly to twice daily. Other airports such as Pontianak, West Kalimantan may handle 50 or more flights daily (see Figure 2).

A STEADILY GROWING DEMAND

The rapid economic growth within Southeast Asia has resulted in sharply increased air traffic through the region and especially within the past five years for Indonesia. With Indonesia's tourist promotion "Visit Indonesia Year 1991", the influx of foreign travellers is expected to increase dramatically.

As a fortunate coincidence to this upcoming demand for air traffic services, the United Nations-sponsored International Civil Aviation Organization (ICAO) conducted a study of communications related to Air Traffic Control (ATC) safety in the Indonesian region during the final months of 1990.

PONTIANAK - A POINT IN CASE:

Headed by Mr. Hance Legere, a Canadian consultant with over 25 years of experience in the field of international air safety communications, the ICAO team studied the ATC-related communications between Jakarta and Pontianak in detail.

Most of Indonesia's airports are equipped with minimal air traffic control facilities. Many of these facilities are 25 years old and have not been expanded to accommodate the recent increases in air traffic. With the exception of selected centers on the islands of Java and Sumatra, many airports rely on localized air traffic control only.

Pontianak was of special interest to ICAO due to its large daily traffic volume and the communications difficulties associated with its remote location.

The team found the reliability of Pontianak-Jakarta ATC communications to be insufficient, based on the current volume of air traffic in and out of Pontianak. This was not due to inadequate facilities at either airport, but rather due to its reliance on an overloaded public communications network to link these facilities.

PROBLEMS IN PARADISE:

Figure 3. depicts the existing communications path between Pontianak's Supadio Airport and Jakarta's Soekarno-Hatta International Airport. Rather than expound on the numerous causes of communications failure between these two sites, it is sufficient to state ICAO's definition of a reliable communications link.

In essence, the ICAO views an ideal communications path for safety-related functions should involve a minimum number of elements that can block or delay transmission. Specific examples of these elements include:

- -cables that, if accidentally cut, can cause total outages lasting hours or days.
- -switching centers that can block calls for periods ranging from seconds to hours.
- -common-carrier microwave or satellite facilities that can entail unnotified maintenance outages and sometimes poor repair response times.

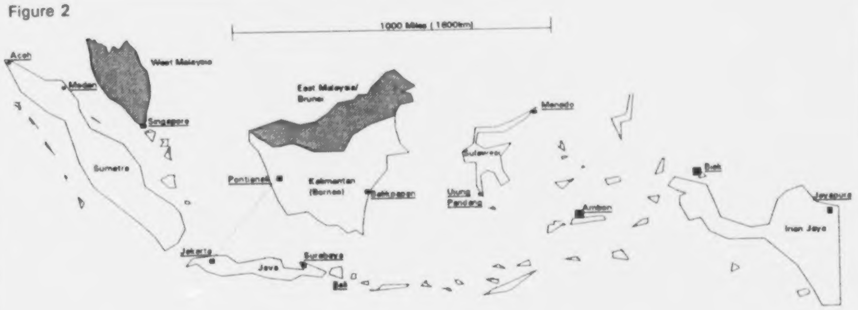
Figure 3 has all of the above elements.

A NORTH-SOUTH ALLIANCE:

Cognizant of the potentially dangerous situation at Pontianak, The research and development branch of the Indonesian Department of Communications (DOC), under the direction of Mr. Theo Widjarnarko, approached PT Elektrindo Nusantara's SmartCom division to devise a solution that was suitable for local operating conditions.

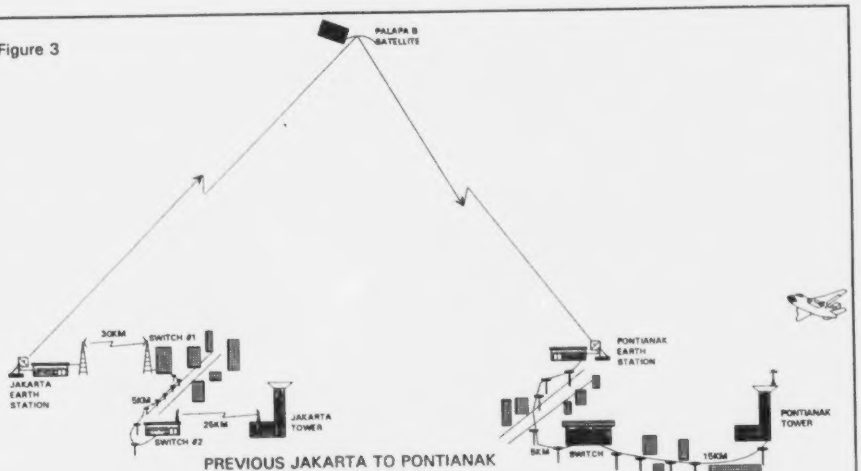
Figure 1

Figure 2


1000 Miles (1600km)
Aceh
West Malaysia
Medan
Singapore
East Malaysia/
Brunei
Menado
Sumatra
Sulawesi
Pontianak
Kalimantan
(Borneo)
Balikpapan
Ujung
Pandang
Biak
Jayapura
Ambon
Irian Jaya
Jakarta
Surabaya
Java
Bali

Map of Indonesia

Figure 3


PALAPA B
SATELLITE
30KM
SWITCH #1
JAKARTA
EARTH
STATION
5KM
25KM
JAKARTA
TOWER
SWITCH #2
PONTIANAK
EARTH
STATION
PONTIANAK
TOWER
5KM
SWITCH
15KM

PREVIOUS JAKARTA TO PONTIANAK COMMUNICATIONS LINK

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Elektrindo, in cooperation of Infosat Telecommunications with the support of the Canadian Government technology transfer program, designed a system that would come as close to the ideal concept as practicable, and offered it for trial evaluation by the DOC.

MEETING THE CHALLENGE:

Again, rather than expound on the advantages and differences of the new solution as compared to the past method, the design goals set out by ICAO are best stated.

In the words of Mr. Legere; "the ideal link is one that does not allow a call to be blocked due to other traffic... where all of the transmission facilities are under the direct control of the local aviation authority... where voice and data transmissions can be routed directly between an aircraft, the local control tower, and other air traffic safety control centers... where voice communication does not suffer more than one or two seconds delay".

The system shown in Figure 4 was installed in August,1990, followed by three months of extensive testing by Mr. Widjarnarko and his technical staff. During this period tests of voice quality, response time, circuit outages, and other operational factors were evaluated.

TECHNICAL DESCRIPTION:

The technical operation of the system is depicted in Figure 5. The system uses digital satellite transmission directly between earth stations located at the bases of the control towers at the Pontianak and Jakarta airports.(see Plate 1)

The satellite link operates at 38.4 Kbps, but can be adjusted for rates ranging from 4800 bps to over 64 Kbps. The antenna diameter for each station is 3.4 meters, (see Plate 2), each equipped with a 2 watt Solid State Power Amplifier.

The transmission scheme is PSK operating in Single-Channel-Per-Carrier (SCPC) mode and provides two voice channels; one ring-down telephone circuit for tower-to-tower coordination and one remote-control extended range VHF radio (see Plate 5) circuit for Air to Ground communications between planes in the Pontianak area and the Jakarta Control tower, plus a 2400 baud synchronous data-only circuit used for secondary radar information.(see Plates 3 and 4). An additional 2400 bps data circuit is available for Telex messaging and remote-control uses.

SYSTEM PERFORMANCE:

In November of 1990, this system was demonstrated to Mr. Legere and his team. After visiting both Jakarta and Pontianak airports, Mr. Legere summarized his findings at a meeting in Bandung, Indonesia on November 27, 1990;

"...the reliability was improved by an order of magnitude...when you pick up the phone, you know Jakarta will answer.... this system has a technician next door, problems are solved immediately and efficiently....vast improvements in operational safety to air travellers....DOC runs the system themselves and can respond immediately to their own problems..."

SUMMARY AND CONCLUSIONS:

The conclusions of the ICAO team reflect those of the Indonesian DOC. The teaming of Elektrindo's SmartCom division, as the local system design and integrator and Infosat Telecommunications, a leading authority on small SCPC networks, has lead to a potential for a rapid and easily-implemented step forward in Indonesia's Air Traffic Safety-Communications. The DOC is presently discussing implementation of this type of system to other important airport locations over the next two years.

Compared to a VSAT network, the simplicity, low cost and high-reliability of these small digital mini-terminals makes them an ideal candidate for use in similar situations in other developing nations or areas not adequately served by existing telephone systems. Using presently-available technology, up to ten telephone circuits plus facsimile, Telex and data can quickly be made available to any location within range of a satellite.

ACKNOWLEDGEMENTS:

Mr. Lance Bailey, Canadian International Development Agency, (CIDA, Inc.)

Mr. Nigel Bailey, President, Infosat Telecommunications Ltd.

Ir. Kusuma Asmara, President Director, PT Elektrindo Nusantara

Mr. Theo Widjarnarko, Research and Development branch, Indonesian Dept of Communications.

Mr. Hance Legere, Consultant, International Civil Aviation Organization.

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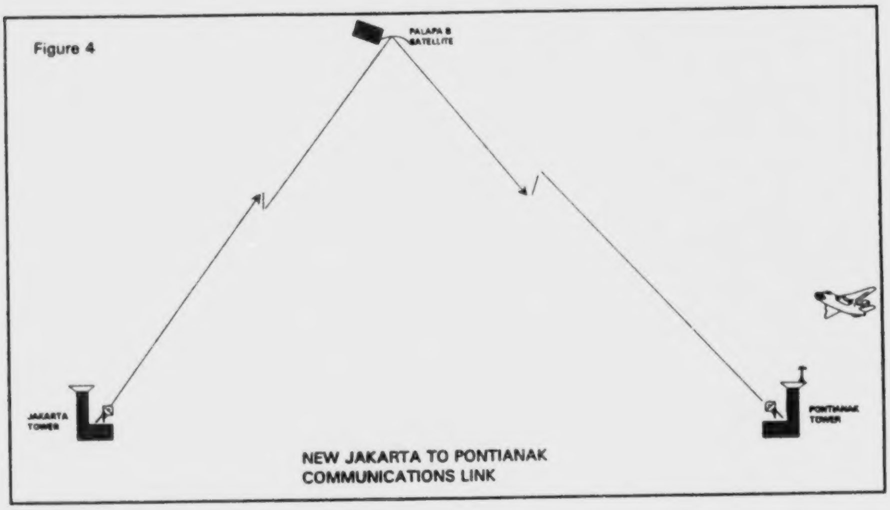
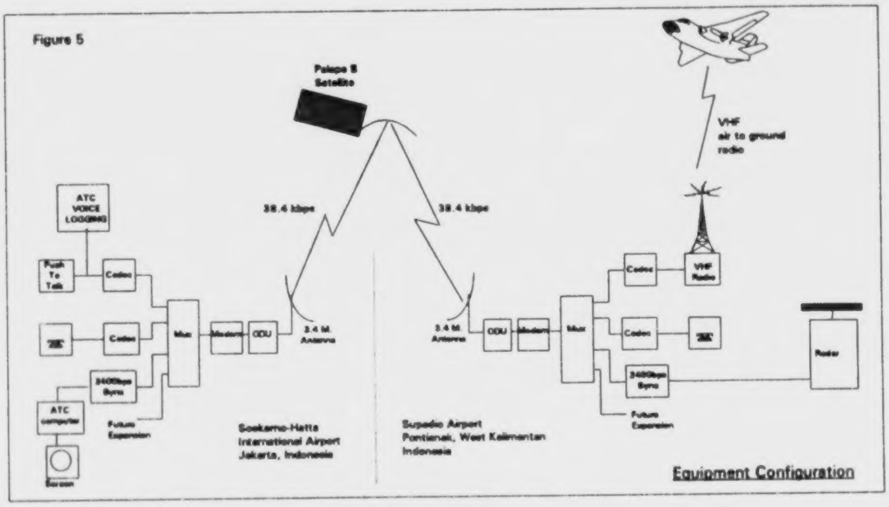
Figure 4


PALAPA B
SATELLITE
JAKARTA
TOWER
PONTIANAK
TOWER

NEW JAKARTA TO PONTIANAK COMMUNICATIONS LINK

Figure 5


Palapa B
Satellite
38.4 kbps
38.4 kbps
VHF
air to ground
radio
ATC
VOICE
LOGGING
Push
To
Talk
Codec
Codec
Mux
Modem
ODU
3.4 M.
Antenna
2400bps
Sync
ATC
computer
Future
Expansion
Screen
3.4 M.
Antenna
ODU
Modem
Mux
Codec
VHF
Radio
Codec
2400bps
Sync
Radar
Future
Expansion
Soekarno-Hatta
International Airport
Jakarta, Indonesia
Supadio Airport
Pontianak, West Kalimantan
Indonesia

Equipment Configuration

PLATE 1
Control Tower at Jakarta's Cengkareng Airport with satellite antenna at base.

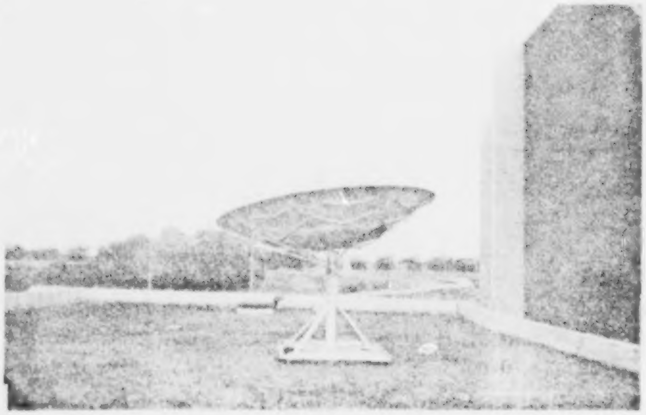


PLATE 2
Detail of Prodelin 3.4m diameter antenna at base of tower. Having 8 sections, antenna is installed easily. Shipping weight is under 300 pounds.

PLATE 3
Elevation view of aircraft radar antenna. The secondary radar beam is carried via the small, flat section at top.

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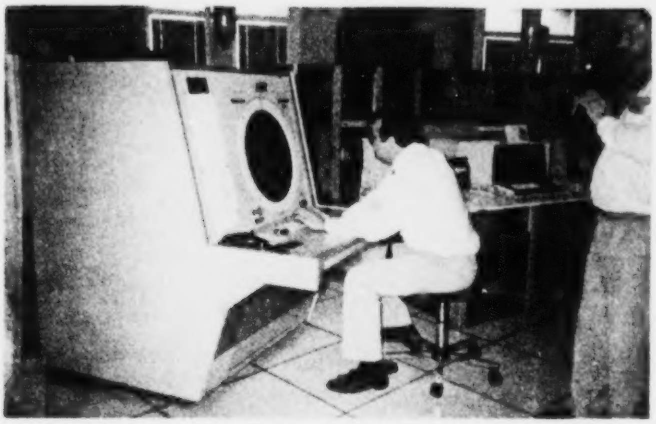

PLATE 4
Secondary radar display inside Air Traffic Control Center at Cengkareng Airport, Jakarta.

PLATE 5
Panel accessing remote control, extended-range VHF radio directly linking Pontianak and Jakarta Air Traffic Control Regions.

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"Canada's Place in Global Telecommunications"
For the 1991 Pacific Telecommunications Conference
in the "Selected Country Overviews" (#4.2.3) Session

Alan Walter
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Abstract

Continuing to serve the needs of customers in the increasingly global telecommunications marketplace is a growing concern for entire the telecommunications industry today. This paper examines the major challenges facing the telecommunications industry in Canada and illustrates how the Canadian experience mirrors the situation other nations face. It discusses meeting the needs of customers in the new global marketplace; conducting business in a changing and unpredictable operating structure, dealing with increased international competition from powerful countries, and integrating new technologies into all facets of the telecommunications business.

We live in exciting times -- times that have been called the "information age", the "Pacific era", the "decade of globalization". Each title is equally appropriate and each title signifies a trend that is deeply influencing the telecommunications industry worldwide.

With the advent of the information age, for example, telecommunications has become one of the fastest growing industries in the world. Current global spending on telecommunications services and equipment is more than $500 billion annually and will reach $1 trillion by the turn of the century.

The telecommunications industry, here in the Pacific, is enjoying a particularly dynamic period of growth. According to Canada's Financial Post newspaper, "The Pacific Rim is the fastest growing region in the world economically... and that's having an impact on the need for telecommunications facilities. In Hong Kong, for example, the demand is growing 50 to 60 per cent a year."

This increasing reliance on international telecommunications is a worldwide phenomenon. Over the past twenty years, international trade has swelled 700 per cent. And current estimates indicate that this is just the beginning.

Companies and nations today depend on telecommunications as never before and the role of telecommunications will undoubtedly flourish. It will continue to shape and influence the way we do business, indeed the way we live, well into the future.

In this paper, I will discuss some of the major challenges ahead for the telecommunications industry in Canada. I believe you will agree that our situation is not entirely unique to our country. Indeed, the Canadian experience, in many ways, mirrors the challenges other nations face today.

To begin, allow me to provide you with an overall perspective on Canada and the organization I represent, Telecom Canada. To do this -- the most effective way I feel possible -- I will compare my country and telecommunications in Canada with that of a country I am sure you are more familiar with -- the United States.

Canada and the United States share the longest undefended boundary in the world, often marked by little more than what appears to be a farm fence. We also enjoy the greatest amount of reciprocal trade of any two nations in the world.

Yet, for our all our commonalities, Canada and the U.S. are quite distinct. For example, although Canada is about 17 per cent larger than the continental U.S., the United States has nine times the population of Canada, according to the latest official figures. In other terms, the continental U.S. has a population density of about 31.5 people per square kilometer and Canada has just 2.8 people for each square kilometer.

What's more, the distribution of our respective populations is very different. About 30 per cent of Americans live within 250 miles of our common border. But, over 90 per cent of Canadians live within 250 miles of the United States. Naturally, because of our demographic individualities, the telecommunications industries in Canada and the United States are also diverse.

As you know, I represent Telecom Canada, the cooperative association of the major telecommunications companies in Canada and our satellite carrier, Telesat Canada. In effect, you could very well say that most of the telecommunications industry in Canada is represented by Telecom Canada and its members.

How does our telecommunications industry compare with the American industry? Well, because Canada has a much smaller population, we earn lower total revenues than our American counterparts. Simply put, the Canadian telecommunications industry has a significantly smaller revenue base.

The second major difference between our industries lies in the scale factor of providing the facilities to serve our customers. For example, according to the 1990 edition of the Telephone Industry Directory, the 1988 book investment for AT&T, GTE and the Regional Bell Operating Companies is about eight times that of Telecom Canada and its members -- despite the fact that the U.S. has over nine times the population base of Canada. Because of Canada's much smaller and more disparate population, we must invest proportionally more to serve Canadian customers than the American telephone companies invest for their customers.

In addition, since the U.S. is right next door, our customers' expectations of us are influenced by their knowledge of the American market. To ensure that we continue to serve our customers well, we have to learn to do more with less.

This illustrates just some of the challenges ahead for smaller nations and telecommunications industries in this new decade of globalization and international competition. There are many other new opportunities and obstacles on the horizon as well.

In this paper, I will specifically address four of the challenges ahead for Telecom Canada and its member companies. Our first and most compelling task lies in continuing to meet the needs of our customers in the new global marketplace. Our second is to do our job well in an operating structure that may face dramatic upheaval in the near future.

Our third mission is to keep on winning even though new heavyweight players are getting in on the action in Canada. And our fourth challenge will be to successfully integrate new technologies into all facets of our business.

Escalating customer needs

First, let's look at our business customers. Canadian business faces a whole new set of parameters in the global marketplace: a growing number of competitors and an expanding market for its products and services. It needs telecommunications services that can help it to beat the competition by increasing sales and keeping costs in check.

Essentially, our business customers want to conduct business on a global scale as easily as they do on a local scale. They need and expect applications that work effortlessly across global networks.

The importance of providing these solutions to our customers, especially for a traditionally trade-dependent nation like Canada, cannot be overestimated. The world in which Canadians conduct business is changing and changing fast, both globally and at home.

As with most developed countries, the Canadian services sector is the fastest growing element in the economy. In the service industry, efficient information management is critical. And information management is made possible through telecommunications services.

Telecommunications is also increasingly important in the manufacturing sector. Canadian manufacturing firms have come to depend on telecommunications facilities that enable them to link manufacturing sites with their head office and R&D locations.

In addition, since the world is shrinking, time is recognized as one of the most significant corporate commodities throughout the Canadian business environment. Reliable and efficient telecommunications services make the most of that precious resource.

Essentially, our business customers expect more and more from their communications services. They are better informed about global developments and more accustomed to the sophistication of emerging information technology. They recognize that the rapidly declining prices of telecommunications services means that they can do more things, at lower cost, and with higher returns on investment.

To respond to the escalating needs of our business customers,one important objective for Telecom Canada and its members is to develop and implement a network that can provide all the capabilities required for today's services. And, of even more critical importance, we must build on that solid foundation with new technologies which respond to future customer needs.

The members of Telecom Canada have already started to implement the essential network technologies that will unlock the power of the network of the future

Just this March, we completed a 7,000 kilometer fibre optic network that extends coast to coast, from British Columbia to Nova Scotia. A second cross-country network - a hybrid of fibre and digital microwave radio - is underway and will be completed by 1993.

We introduced CCS-7 -- Common Channel Signalling System Number Seven -- on September 1, 1989. This full-time, high-speed digital communication channel provides a variety of innovative customer services.

Our core network is also undergoing significant changes with our drive to replace all analogue switching and transmission with digital systems. By 1994, essentially all of the subscribers in Canada will have access to digital switching.

As we devote much of our capital resources to upgrading our national network and work to reduce costs for our business customers, however, we remain cognizant of the needs of our residential customers.

They too are more aware of world events. They are looking for products and services that are innovative, that save them time and that make their lives easier. At the same time, however, they have come to expect very reasonable prices. Balancing the needs of Canadian business with the needs of Canadian consumers is a tough juggling act.

Structure

The world I have described is fast-moving and complex -- altogether different from the simpler world of static technologies, happy customers, and steady revenues that the telecommunications industry once knew.

However, in Canada, as in other countries around the world, the policy structure of the telecommunications industry, hasn't progressed at the same speed. Most people realize that it has to change, but unfortunately, the proposed changes invariably fail to address the new global nature of telecommunications.

Canada simply does not have a legislative structure in place to deal with the issues facing our industry. The various levels of government in Canada are still debating the mechanics of regulatory responsibility.

Nevertheless, our regulators in Canada face an ever-increasing number of issues of increasing complexity and they must make these decisions faster. Without a solid policy structure, these decisions sometimes fall short of the mark in confronting the real issues.

For example, regulatory decisions have allowed resellers to resell private line service from Canada to U.S. long distance networks.

The Canadian Radio-television Telecommunications Commission (CRTC) has recently issued a Public Notice asking, among other questions, whether restrictions on the use of Canada-U.S. private lines can be effectively and uniformly enforced, and whether by-pass is likely to be significant.

Imagine asking these questions after the long series of decisions has been made. Needless to say, given the attractive prices of the nearby U.S. networks, many Canadian firms are moving ahead quickly to take advantage of this new opportunity.

However, if we try to match U.S. prices to retain our existing share of the traffic, we are faced with some difficult decisions. This is a scenario that will probably become more common in other countries in the future.

Another major development on the Canadian regulatory scene includes the possible introduction of a form of regulated competition in long distance service. Most of our member companies already face competition in all areas of business except for long distance and local service.

That may change, however, in the next few years. The Canadian Radio-television Telecommunications Commission (CRTC), is now considering a number of applications from companies who want to enter the lucrative long distance market, essentially on the basis of regulated competition, to compete against the Telecom Canada members.

The Telecom Canada member companies feel that will hinder the efficiency of our public network in two fundamental ways. The first impact will be a loss of the efficiencies inherent in economies of scale. This is particularly important in a country like Canada, which as I said before, has a large land mass yet a small, dispersed population.

The second impact will be the shrinking of the pool of funds available for network investment and for research and development. As I pointed out earlier, Canada already invests more of its relatively scarce revenues in its network than practically any other country in the world, on a per capita basis.

Moreover, new competitors in Canada will devote most of their energies to consolidating their market position in their startup phases. The existing carriers, on the other hand, will have to devote more of their resources to dealing with short term issues and thus pay less attention to their long term plans.

This means that at a time when telecommunications is more important than ever before to the success of Canada as a trading nation, there will be less money available to ensure that Canada's telecommunications system remains world class.

I believe the key to resolving this issue lies in ensuring that the Canadian players in our domestic telecommunications industry are as strong as they can possibly be and on an equal footing with foreign competitors.

Like other countries currently embroiled in the same type of struggle, Canada must carefully examine its policy and regulatory structure to ensure that the players who have the best chance for international success actually get that chance.

Increasing Competition and Strategic Alliances

Again, like other countries and, indeed, like our business customers, Telecom Canada and its member companies now operate in an increasingly global business environment.

For example, as a result of the Canada-U.S. Free Trade Agreement which came into effect on January 2, 1989, Telecom Canada and its members now operate in a North American market. It is also clear that some U.S.-based carriers are moving vigorously to take advantage of the opportunities in enhanced services opened up by this new Trade Agreement.

Obviously, the day is past when regulators and legislators could shield a domestic market from foreign competition. International treaties and obligations, such as the Free Trade Agreement (FTA) and the General Agreement on Tariffs and Trade (GATT), require Canada to provide access to Canadian markets.

The sort of arrangements that we have under the FTA are similar to those being discussed in the latest round of GATT negotiations. In fact, Telecom Canada has proposed to our trade and communications officials that Canada should not agree to anything more liberal than the FTA arrangements.

In any event, the level of competition in our Canadian market will increase as we face not only American firms but European and Japanese companies as well. And with that comes the inevitable pressure on Canadian telecommunications companies to lower their prices in some areas and to continue to improve their performance to be more competitive on a global basis.

Telecom Canada and its member companies have achieved considerable success in that area. A forty per cent reduction in the price of long distance service in five years is just one indication of that success.

However, while we work hard to reduce prices, to improve service, and to stem the tide of foreign competition, we also know that we must forge strategic alliances with foreign carriers to meet the global needs of our major customers.

To make these alliances flourish, we'll need revenue-settlement arrangements that recognize the need to keep all the partners viable, but that keep prices at levels which stimulate new applications.

We have no choice. We simply do not have the necessary resources to invent, develop, and market -- on our own -- every product and service needed for the global success of our customers. We must team up with other organizations.

To negotiate such agreements, Canada must be in a strong, unified position. We must be able to measure up to the best and thereby forge solid, mutually beneficial alliances. Powerful teams don't want weak players. They want players who will add to their competitive strength.

Technology

Which brings me to our fourth challenge: successfully integrating the right technology decisions for the future to help ensure future competitive strength. To accomplish this, an industry must have two essential ingredients in place: progressive research and development activities and effective education and training systems for its workforce.

An industry's national R&D record is closely related to its ability to build strategic international relationships. However, according to the Conference Board of Canada, about 97 per cent of all the technology used in Canada is imported.

Our relatively small population base together with the fact that there is a substantial amount of foreign owned or subsidiary based business in Canada, makes it difficult for our country to be a major developer of technology.

In fact, some business analysts maintain that only two per cent of Canadian corporations invest in R&D and of those corporations, seven per cent account for nearly two-thirds of all the R&D that is carried out in Canada. A large part of that seven per cent is essentially the member companies of Telecom Canada and their research subsidiaries.

Because of our commitment to R&D, Canada once led the world in the development of microwave, digital and satellite communications. The Telecom Canada members are still investing heavily in R&D. But we, along with other Canadian businesses, and indeed other smaller countries, simply don't have the capital resources to match the R&D programs of some of our foreign competitors.

All of this paints a fairly sobering picture of the state of research and development in Canada. Yet it's one of the most vital areas that we must work to improve if we can ever hope to secure our place in the global marketplace.

Equally important to R&D in ensuring our competitive edge, is the ongoing training and development of our most important resource: people.

We now live in a knowledge-based economy which is increasingly dependent on technology for continued growth and effective international competitiveness. In this new economy, learning, information and skilled intelligence are the raw materials.

In other words, our systems to improve our human resources have become as vital - if not more vital - to our national infrastructure as roads, railways and ports were at the turn of the century.

And the workforce of the future will need to learn continuously as economic, social and technical factors move in concert with international currents. For example, by the year 2000, forty per cent (compared to 24 per cent today) of the new jobs in Canada will be highly skilled, requiring solid reading, computing and thinking abilities.

One in three jobs will probably require a college degree and, according to a recent Employment and Immigration Canada study, "It is estimated that during the 1990s, almost two thirds of all new jobs will require more than 12 years of education and training. Many of the new jobs will demand more than 17 years of education and training."

We know that the increasing pace of technological change means that today's worker may have to be trained for three or four different careers over the course of a lifetime. We also know that Canada has some work to do in building a workforce that is capable of meeting the requirements of careers in the future.

To sum up, the four most important challenges facing the Canadian telecommunications industry today are --- continuing to exceed our customers' expectations -- in a changing industrial structure -- while dealing with new and powerful competitors and partners -- and successfully integrating the right technology for the future.

To prosper in the information age, the Pacific era, the decade of globalization, the telecommunications industry in Canada and others around the world, must innovate in all the aspects of running a business.

We must also remain alert to the changing tides of the global economy and be flexible enough to change direction quickly and efficiently. As Canada's former Prime Minister, Pierre Trudeau, once remarked, "Living next to the United States is in some ways like sleeping with an elephant. No matter how friendly and even-tempered is the beast ... one is affected by every twitch and grunt."

In today's world, Canada and other countries like Canada, will most certainly continue to be affected by every move our bigger and more powerful allies make.

But, despite these challenges, our industry must never forget its most fundamental purpose, indeed its promise: to serve its customers, both business and residential, to the best of its ability. That is one promise Telecom Canada and its member companies intend to keep.

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A Status Report on
China's Telecommunications After 1989

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1. Abstract

Despite the political turmoil in 1989, China's telecom is in the massive transition from manual to automatic; analog to digital; POTS to integrated services. The "slanted policy" has been essential for the continuing growth. Future development will suffer from severe fund shortages, but the goal for 2000 is achievable.

In June 1989, an unprecedented democracy movement erupted in China. A year after the political turmoil, questions still remain among the telecommunications community in the Asia-Pacific region as whether China will continue the reform as promised? What is its current status in technology, implementation, and services? What are the constraints and possible solutions? Is China still a viable telecom market for foreign capital and products?

For the companies that are doing business in China, or those contemplating to enter the market, the situation appears nebulous and gloomy. To resolve some the concerns, this paper provides a status report on the current development of China's telecom. Information is collected from a recent field trip, series of interviews with key persons at the Ministry of Posts & Telecommunications (MPT), and research on available literature.

2. The Current Status

The country's political situation may have had a negative impact, but it's fair to say that China's telecommunications is continuing to stride with a fast pace. In general, the industry is experiencing a transition in three directions: From manual to automatic switching; from analog to digital communications; and from traditional telephone service to integrated services. Research, manufacturing and implementation of digital switch, packey switching, fiber optic trunks, digital microwave, satellite communications, mobile systems, and ISDN are all accelerating. In 1989, total telecommunications (excluding postal services) had a net income of 7.56 billion yuan RMB ($1.68 billion), which was a 27 percent increase over 1988. The profit for the first half of 1990 was 4.4 billion yuan ($978 million), a 25 percent increase over the same period in 1989. See Table 1 for telephone growth between 1988 and 1989. Table 2 provides key indicators of the industry for the same period. Figures 1 and 2 confirm the continuing growth between 1985 and 1990.(1)

Table 1

Statistics on Telephone Service

	1988	1989
Telephone Set on Public Networks(mil.)	9.4	10.9
Phone Subscribers(mil.)	4.7	5.7
Capacity of Public Switching(mil. lines)	5.6	10.3
Automatic Exchanges (cities; %)	90.6	93.0
Connect Ratio in Local Calls(%)	56.9	58.9
Connect Ratio in Long-Distance Calls(%)	86.8	87.5*
Phone per 100 People(%)	0.86	0.98
Waiting List (households in mil.)	0.48	0.52

* About 50% of long-distance calls are placed by operators when direct dialing is not available.

The following analyses are made from the tables.

1) The total number of telephone sets increased by 16 percent from 1988 to 1989. Given the present growth scale, it should have reached the projected goal of 13.5 million sets in 1990, which renders a 24 percent increase over 1989. In order to achieve 33.6 million by the year 2000, an annual increment of 2 million sets is required, which translates to an average growth of 10 percent a year onward. If the present speed is maintained, 2.6 phones per 100 population (i.e., 2.6%) by 2000 will be achieved some time earlier; a penetration of 3 percent or higher is more probable (the present ratio is one percent).

Figure 1 Growth of Telephone
(1985-1990)

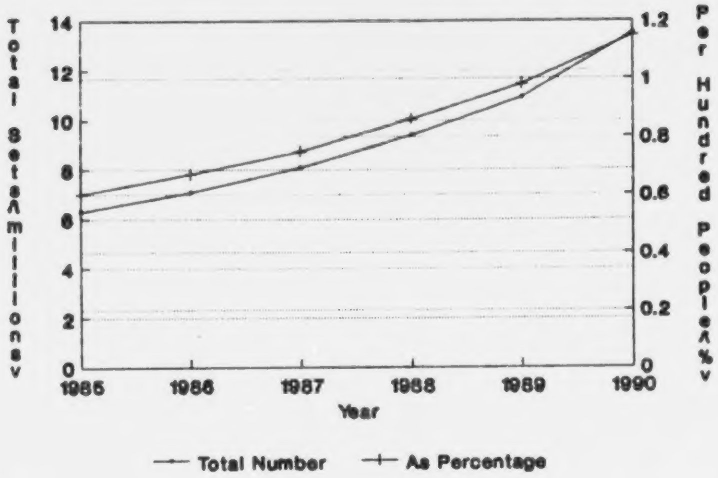


Figure 2 Telecom Index
(1985-1990)

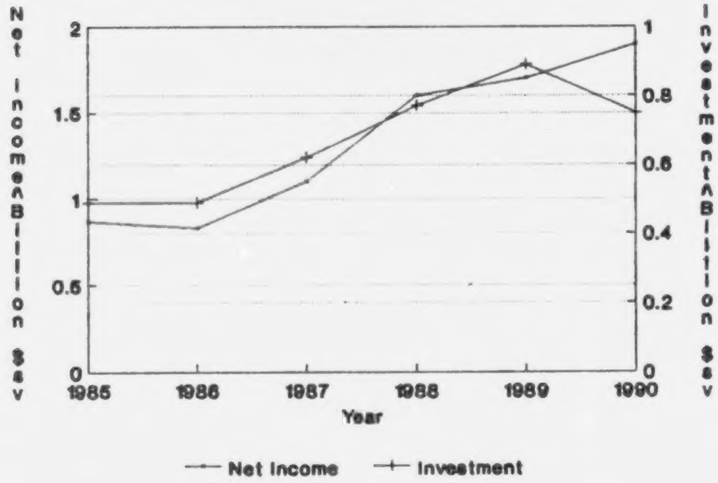


Table 2

Telecom Revenues and Investments
(US$ in Billions)

	1988	1989
Total Telecom Income (excl. postal servs)	1.32	1.68
Total Telecom Expend.	0.82	1.00
Income from Phones	1.12	1.41
Telecom Investment	0.59	0.89
Invest. in Phones	0.36	0.59
Telecom Invest. as of GNP(%)	0.21	0.26
Telecom Invest. as of Nat'l Investment	0.99	1.00

Sources: Center for Scient. & Tech. Info.(STIC), MPT; Aspen Group, 1989, 1990.

2) The growth of telecommunications is much higher than the economic development during the same period. If we consider the gross income of total telecom services, the gap is even larger: 27 percent. This strongly indicates telecom is a development priority. In a centralized economy like China, outpaced investment in telecom is absolutely crucial for a sustained growth.

3) The percentage of telecommunications investment in the national investment had very small variations over the years: around one percent. This seems to contradict with a rapid growth as discussed earlier. It is because government investment is just a small portion in the total industry investment, total state subsidy no longer exists in China (will discuss later). Nevertheless, the percentage is still low comparing China's tremendous communications needs. The ratio, after all, may not well justify the optimal investment scale; most countries invest about 3 percent in telecommunications; developing countries have a little higher ration.

3. The Technology Boom

The technological development over the past two years has had a deliberate focus on digital switching; transmission (microwave, satellite and fiber optics); packet switching networks; voice and non-voice services. The paper will discuss digital switch market, packey switching, and integrated services.

Digital Switch/SPC automatic exchange (stored programmable & controlled). It is the fastest growing segment. Since the first SPC switch was introduced in 1982, its proportion in total switching capacity has soared rapidly, from .9 percent in 1984 to 40 percent in 1989, with an annual growth rate of 60 to 160 percent.

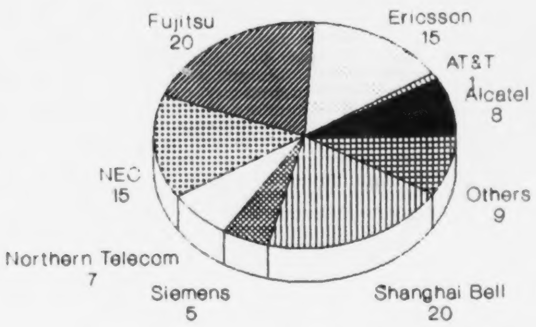
The digital switch market consists of two parts. One is imports, notably from Ericsson, Alcatel, Northern Telecom, NEC and Fujitsu. They are used primarily in central offices at national and local networks. The share of American imports, e.g., AT&T's 5ESS series, is surprisingly small: less than one percent. Figure 3 provides the market share for imported switches in 1989. Three factors may have contributed to the shares. First, almost all European and Japanese companies sell their products in China under their governments' loans, but the U.S. products are not. The purchasing has to rely on domestic finances, such as from limited budget and/or collective funding. Also, foreign loans require that the purchase be made with the company whose government provides the lending. As a result, China imports more switches from Western Europe and Japan than from the U.S. Second, the price for the U.S. products is usually higher than others. Given the limited funding, the Chinese will go with the lower price if performance can be matched. Third, once the initial purchase is made, users tend not to change but rely on the specific supplier for technical and economic conveniences. Ericsson, NEC, among others, entered the China market as early as late 1970s and have created a large user dependent base. It seems the present market shares are quite stabilized with limited openings for new comers.

The other source for digital switch is the Chinese manufacturing capability which has expanded rapidly since 1982. It can be further divided into two categories. One is technology transfer or joint ventures with local labor and assembly, such as the Shanghai Bell Telephone Co.'s S1240, Tong Guang-Nortel Ltd. Co.'s Meridian SL-1. By 1990, there were about a dozen companies engaged in some form of technology transfer. Table 3 lists major manufacturers and their product specifications.

The second category is domestic manufacturers. One such example is the First Research Institute of MPT in Shanghai. Its DS-2000 digital switch was used in the first "Integrated Digital Network" trial in Beijing in 1989. The quality and reliability were said to be comparable to the imports. According to the MPT's Communications Inspection Center, by the end of 1989, there were about 100 companies making PBXs and CO switches. Most of them use analog space-division multiplexing (SDM) in contrast to time-division technique (TDM) by the first category manufacturers. Typically, the line capacity of PBXs is between 50 and 200; and 400 - 2000 lines for CO switches. The annual output of domestic SPC switches is about 150,000 with a growth rate of 15 percent. It is estimated that by the end 1995, the domestic capability should be reaching 500,000 circuits.

The MPT officials stressed that the SPC switch market (digital & analog) is having the rapid expansion period in China. Since 1989, the

Figure 3 China's Digital Switch Market
(1989, in % Shares)



Sources: Aspen Group; STIC, 1990

Table 3

Joint-Ventures and Product Specifications

Company	Partner	Product	Transmission Method	Comm. Type	Annual Capablty(1)
Tong Guang-Nortel	Northern Telecom	MSL-1	PCM-TDM	2B+D	300,000(2)
Beijing Wire Comm. Sys. Co.	Ericsson	MD-110	PCM-TDM	2B+D	100.000
Beijing Info. Sys. Ltd. Co.	Siemens	EWSD	PCM-TDM	2B+D	300,000(3)
Changde, Suzhou & Zhenhua Elec. Industry Co.	Phillips	SOPHO-S	PCM-TDM	2B+D	N.A.
Xinguang Elec. Beijing 239 Manuf.	Siemens	HICOM	PCM-TDM	2B+D	N.A.
Shanghai Int'l Digital Telephone	GPT (UK)	ISDX	PCM-TDM	2B+D	100,000
Guangzhou Wire Ltd. Co.	Harris	Harris 20-20	PCM-TDM	2B+D	100.000
Shanghai Bell Telephone Co.	BTM (Belgium)	S1240	PCM-TDM	2B+D	300.000
Tianjin Telecom Manuf.	NEC	NEAX61	PCM-TDM	N.A.	N.A.(4)
China Comm. Sys. Engineering	TELEX (US)	SCX-1200	N.A.	N.A.	N.A.

(1) Number of transit circuits; at full capacity. (2) With 10%-15% overseas sales. (3) Production begins in 1990. (4) The project was delayed due to economic sanctions.

Source: Center for Scient. & Tech. Info. (STIC), MPT, 1989; Aspen Group, 1990.

supply has been behind the demand with considerable gaps. The estimated demand in 1990 was about 500,000 circuits, primarily for digital TDM-PCM switches. The demand comes from local (provinces & cities) needs for replacing crossbar capability, putting in more telephones, and emerging hybrid services. The high switch demand in China contrasts with the flat PBX market in the West, especially the U.S., since 1987. It thus suggests an ample market for imports for at least 3 - 4 years. In fact, Northern Telecom, Alcatel and Ericsson, among others, have acknowledged that China is an important market, and they are trying to maintain long-term engagement with China's telecom development.

Since 1986, a testing and inspection procedure has been imposed to ensure quality, standards and interconnectivity. Only those switches that pass the inspection are permitted to enter the public network. The policy also applies to foreign products. In a recent announcement by the Communications Bureau of MPT, strict control would be enacted for new imports and a limited number would be allowed to operate in public networks. The policy seems based on the supply-demand equilibrium, with the pivot of domestic capability. In other words, the volume of imported products is determined by the domestic output. The new procedure will certainly restrict substantial share of foreign products. By our eatimates, as the domestic production gradually levels with the demand, the proportion of imported switch will decline from presently 50 percent to less than 30 percent in five years. The new policy, however, also has an effect on protecting the established vendors from new competition since their products are widely used. The policy does not apply to new technologies, such as ISDN, T-1, fiber optic systems, and data terminal equipment. Demand for these applications will definitely arise in the near future.

In 1990, the total switch (SPC & crossbar) production increased a million lines from the year before. Since the industry has turned to digital switching technology, automatic crossbar manufacturing is dwindling, from 25 percent of annual growth in 1984 to about 18 percent in 1989. However, the increasing communications needs in the rural areas make crossbar still a viable product. (China has 2,200 counties, 60,000 villages, and millions of rural enterprises.) China presently has an annual production of 600,000-circuit automatic crossbars. According to the MPT, the output is below the demand; a growth rate of 20 percent is likely during the next few years.

Packet Switching. The first public packet switching network, Chinapac (codename DNIC 4602) has been in operation since October 1989. Developed by the Institute of Data Communications Technology (IDCT), MPT, with supplies from Cap Sesa, a French telecom company, the network uses three DPS-II nodal exchanges in Beijing, Shanghai and Guangzhou, and eight concentrators in other cities. Altogether, the network serves 500 ports nationwide. Two direct international lines are provided to France and the U.S. through the gateway in Beijing. Chinapac complies with the lower four layers of the OSI communications standards, and CCITT's X.25 packet switching protocols, which establish extensive access from data terminal equipment (P-DTE), such as computers. The access of telephone to Chinapac is through X.28 to packet assembler/disassembler (PAD) for non-packet users, and X.32 for packet users. The transmission speed on Chinapac is 300 - 9,600 bps, essentially for public telephone services, telex and low-speed data communications. A higher speed of 64 kbps is expected some time soon for new applications. Services on Chinapac include, a prototype of videotex, electronic mail and telex using Chinese characters, and directory assistance. By 1990, about 40 corporate users (primarily government and research) have signed up for the service.

Although the French companies (Cap Sesa and Alcatel) have been the sole suppliers for Chinapac, the Chinese are looking for alternatives. According to IDCT, the French equipment is not technologically advanced, and some components have to be sought from other suppliers. In 1990, IDCT received a project fund of $850,000 from the United Nations Development Program (UNDP) for 1991 - 1995, and is looking for partners from the West. Although the Chinese have done good research on packet switching technology, they have suffered from the inability to make sophisticated and reliable products. For the next few years, they will have to rely on the Western technology and products.

Non-Voice Services. The development in switching and transmission capacity has stimulated non-voice information services. Since telecommunications in China is a state protected monopoly, there is no division in law between a "carrier" and "information provider," as in the case of the United States. As a result, all information services through public networks are granted exclusive rights to the MPT and affiliated organizations.

So far, the following international services are available for public access. 1) Bulletin board/ electronic mail: the U.S.: Western Union: WU FYI BGTN; WU, Update SVC. MCI: MCI Insight. RCA: MCI FYI. South Korea: KTA (Korean Telecom Authority). Thailand: CAT DBS. 2) Database service from Great Britain (Reuter), Austria, Germany and Italy. Through international gateways, users can access a number of databases in the U.S. (e.g., ORBIT, Dialog, etc.), and other countries. According to Beijing Bureau of Telecommunications Administration (BTA), there are about 50 corporate users on these services.

In addition, Chinapac provides a number of non-voice services. The first Chinese character videotex trial was conducted in Shanghai in October 1990 by IDCT. The system uses CEPT (European Conference on Posts and Telecommunications) standards, and proposes three terminal types: France's Minitel terminals (cooperated with France Telecom) with Chinese character display (developed by IDCT); PCs with modems of 1,200 bps; and TV sets with adapters to receive videotex signals. The cost for using the service is not disclosed; it is doubtful at this time that videotex in China will expand quickly due to limited access, financing and crude content. A new telex service is also available on Chinapac. At 300 bps PC users can communicate through gateways with 4,000 ports in 80 cities.

4. Policy Highlights and Analysis

The telecommunications did not suffer terribly from the backlash of Tiananmen crackdown in 1989. Instead, it is still on the top of the country's agenda, supported by the following policies. These policies also will play a critical role during the "Eighth Five-Year Economic Plan" (1991-1995).

1) A "slanted policy" has been in effect since the late 1980s. It is to provide disproportional favorable measures for the telecom industry against basically unchanged total investment scales. Specifically, the industry has been enjoying the following benefits from the policy. a) Taxation. Telecom pays only 10 percent of its total revenues to the government, retaining 90 percent for re-investment. b) Revenues from non-production businesses such as tolls and other operating incomes are allowed to be kept as much as 90 percent by the industry. c) Loans. Telecom may delay the due payment as much as 90 percent. These favorable measures certainly have had a positive effect, especially when the country is trying to retrench its budget. In fact, investment in telecom industry has not been reduced but increased compared to other industries.

2) The rapid development is the fundamental force for changes in financing. The fund shortages had long existed even before 1989, and was aggravated by the increasing telecom expenditures and the economic sanctions by the West. The central government financing used in China for nearly 40 years is no longer a sufficient resource to accommodate increasing local needs and different technical requirements. The lack of funding is more serious a restraint than ever as the country is laying down the goals for the decade. To alleviate the burden, since mid-1980s, China has implemented a diversified financing structure (see Table 4). It is to divert investment from one central source to numerous local sources.

Table 4

Telecom Finance Distribution

Types	Financing Sources
Inter-Province*	MPT, Part Local
Intra-Province**	Provincial
Inter-city	City

* Trans-national transmission trunks (first tier) which are typically thousands of miles in length, with systems equipment.
** Second-tier trunks with hundreds of miles in length.

The outcome of the policy has been very encouraging. It has inspired tremendous enthusiasm from local authorities to develop their own telecommunications infrastructure. Since local governments now have more freedom in decision-making and retaining the profit, they have very high motivation; reports from several provinces indicate that higher profits level is positively correlated with better understanding of strategic values of an advanced telephone system in place. Interestingly, such high enthusiasm sometimes goes beyond the MPT regulations in purchasing digital switches from the West and installing cellular networks.

The diversified financing scheme has also had other consequences. For example, independent local funding has made local projects less dependable on the state planning. Also, it has caused price hike. For nearly 40 years, telecom services in China were heavily subsidized by the government/MPT; the price was so low that the service was virtually free to the user. This has changed dramatically along with new financing policies. The telephone installation and service charge, for example, has increased more than 100 percent during the past year alone, but it did not seem to disturb the public.(2)

Nevertheless, the fund shortages will be a serious problem in the future. By our estimate, in order to sustain a continuing growth, the industry needs at least 4 - 5 billion yuan (about $1 billion) a year, but the funds available from the central government will only be a quarter of the amount required. The present "assorted pie" financing provision between the MPT and local sources may alleviate the problem at best, but the shortage will inevitably impede the growth speed.

Foreign Capital has been an important source for telecom financing since the early 1980s. The government really wants foreign investment as much as possible, but its wishful thinking is often faced with cautious Western investors and vendors, especially after the Tiananmen event in 1989. To encourage foreign investment, China has instituted a number of policies assurring joint ventures, Western-style management, and profit returns. But these still cannot eliminate concerns about China's political instability and economic reality. In our view, the key issue is that the Chinese government is always uneasy about foreign involvement, in fear of losing control. The MPT has reiterated that foreign capital is welcome, but systems operation, management, and other administrative duties must be controlled by the MPT. In other words, investment can be mixed, but only one owner. By far, this policy has been watched very closely by the MPT. The policy dilemma represents the biggest challenge for the government, and there is no ready solution any time soon.

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The brutal suppression in Tiananmen Square has reverely damaged the government image of sincerely pushing reforms. The economic sanctions against the Chinese government have had serious repercussions despite the government's denial. For one, many foreign lenders (primarily government sources) have terminated or postponed loans to China. The action has disrupted a number of telecom projects (mainly local projects that were most vulnerable). Japan is an exception, who has confirmed to resume its government loans of 36.5 billion yen ($276 million) to China. The package covers five years beginning in 1990.

Centralization. Parallel to the foreign investment policy, centralization remains as an insuperable rule. The State Council recently approved an MPT's reform plan which has a strong tone on the importance of a centralized telecom structure and operation. The MPT again is assured to exercise its supreme power as the "highest administration organization" in the country.(3) The privatization in agriculture and other industry sectors does not seem nearly possible in the telecom industry. The backdrop of centralization is the growing tendency among local authorities who are gaining more power and acting more like independent entities. The future change of China's telecom structure will largely depend upon how these two forces interact and make compromises.

The economy of scale seems to be another reason for a centralized hierarchy. The MPT argues that China is different from other countries that have decentralized their telecom industry, because China's economic base is weak, and telecom services are below the world's average level. If decentralization was introduced now, the user would suffer since competition in such an environment would confuse the market in technology and standards. As a result, the user would have to pay a higher price for the service. In addition, competition would not achieve the optimal use of fund, which is already a scarce resource. A high price would also delay telephone penetration and services since the majority of the population could not afford an expensive utility.

These justifications seem to contradict the more flexible financing policy discussed earlier, and it has caused some confusion among Western telecom analysts.(4) We are reminded that the "assorted pie" financing is more a convenient measure to overcome severe lack of fund. If the government had enough to finance the industry, it would not surrender its power since in so doing it has to take certain risk in losing control. Therefore, under the current situation, a diverse financing structure and a rigorous central control can coexist and no serious conflicts have been found.

Public vs. Private Networks. Recently, a policy shift has been proposed in favor of public networks. For a long time, the state made low investments in the public networks; its slow growth forced ministries and industries in the early 1980s to develop their own networks, including the Ministry of Petroleum Industry, Ministry of Railways, and financial institutions. However, private networks suffer from poor cost-performance, and inadequate planning and management. Worse still, the proprietary protocols make them impossible to interconnect each other when such needs arise.

The following recommendations have been proposed and are likely to be endorsed by the government.

1) Development of public networks should be given high priority in national communications systems; it will ensure maximum access and use.

2) Protocols and interfaces must comply with international standards. The CCITT recommended standards and the OSI communications model are the basis for research and development.

3) Encouraging the use of public networks, including leasing circuits (virtual private) for specific communications.

4) The construction of long-haul trunks, particularly the "first tier" national transmission networks must be in high priority. It is the key to improving line connect ratio and increase in CPE installations.

Obviously, the bottleneck in promoting public networks is finance. As the foregoing section indicates, an increasing investment has to rely on commitment to the "slanted budgeting policy" and to secure foreign loans, neither of them is totally clear of uncertainties.

5. Concluding Remarks

China's telecommunications development has basically followed the due course set in the early 1980s. Although suffered from political turmoils and economic pressure from the West, the industry has survived a continuing growth in 1988 - 1989. The pace for switching technology, transmission capacity, telephone penetration, and enhanced services will likely continue during the "Eighth Five-Year Plan" period (1991-1995). The goal of 33.6 million phones by 2000 is very likely to be a reality given the present speed.

The fund shortages may have revealed a hidden agenda in international investment environment, which, explicitly or unconsciously, has made a shift from China to other markets. In our view, there is a certain cycle which international investors follow. In the early 1980s, it realized the potential growth in Asia-Pacific; such compulsion brought huge investment into the region. China opened its door to the West around the same time, thus caught the oppotunity to absorb billions of dollars. The investment penchant lasted about a decade and is gradually ebbing. During this period, China unfortunately fell several times to the vicious instability, and Europe decided to become one unified common market. These, among other factors, may have contributed to the current situation. The officials at MPT seem to be aware of the investment shift, but admit they can do little but wait for foreign investors to re-discover its market. This may take some time since the European market looks very alluring at the moment. According to a 1990 directory, there were only about 30 Western high-tech companies having local offices in China, and an even smaller number of which conduct visible business there. Given the size of China market, such number is iota. The China market is largely neglected by the Western investors, particularly Americans.

This conclusion, however, by no means suggests that China will recede from modernizing its telecommunications. China will continue to strive. With tireless courtship for Western capital and technology, China may have to rely on its own resources and capability to achieve the goals. A continuing growth is probable, but fund shortages will inevitably erode the ambition.

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6. Notes/References:

(1) For a historical review, see Lin Sun, "China Follows the Long Road to Telecom Growth," Telephony, pp.22-30, Vol.218, No.22, May 28, 1990.

(2) In Beijing, for example, the cost for installing an SPC telephone is 5,000 yuan, but the charge a year ago was only 2,000 yuan, a 30 percent of the total cost. It would cause higher losses for the phone company if more phones to be installed. Since July 1990, the BTA has increased charge for phone installation to 5,000 yuan, and monthly fee from an average 19 yuan to 28 yuan. Other localities have increased prices in the similar scale. Interestingly, the nationwide price increase did not dissipate the public demand; there were about 500,000 homes and company users waiting for the service in 1989. The number is ever growing. See Renmin Youdian (People's Posts & Telecommunications), No.1471, July 31, 1990.

(3) See Zhou Changyong, "Strengthening Management and Development of Communications Industry," World Telecommunications, p.3, Vol.3, No.1, February 1990.

(4) Rationalization in analyzing China's telecom policy seems to be a common approach, see Jeffrey Sprafkin, "China Loosens the Reins," Communications International, pp.39-43, April 1989. The speculation that the diverse financing will diffuse liberalization to other aspects has been inaccurate. There has been a such tendency, especially at local levels, but it clearly is not the government's intention.

TELECOMMUNICATIONS IN KIRIBATI
MANAGING CHANGE IN A SMALL ISLAND NATION

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The following paper arises out of the author's experiences in Tarawa, Republic of Kiribati as Co-Managing Director of Telecom Kiribati LTD, during the two year management agreement between the Government of Kiribati and OTC International.

KIRIBATI - SOME FACTS AND FIGURES

Kiribati(pronounced Kiribas) comprises some 33 islands spread over more that 5 million square kilometres of the central Pacific Ocean. They are in three groups known as the Gilbert, Phoenix and Line Islands. Total land area is only 719 square kilometres. With the exception of Banaba or Ocean Island, the islands are coral atolls which rarely rise 4 metres above sea level. The soil is mainly sand or coral rubble which allows only coconuts, taro, breadfruit, and pandanus to grow well. The islands straddle the equator and the climate is hot and humid with a mean annual temperature of 28 degrees centigrade. The people, known as I-Kiribati, speak I-Kiribati, and are of Micronesian origin. Approximately 21,000 of the nations 64,000 people reside in Tarawa which is the capital. the predominant religions are the Kiribati Protestant and Roman Catholic Churches. Kiribati is an independent republic having gained its independence from the United Kingdom in 1979.

BACKGROUND TO OTC I INVOLVEMENT - PRIVATISATION

During the years 1981 -1985 the telecommunications infrastructure on Tarawa was developed under European Community aid to provide a standard B earth station, one digital international exchange, 3 digital local exchanges with digital microwave interconnection, a complete underground cable network and subscribers premises equipment. It was a requirement of the aid agreement that the new network be operated as a business and that, if possible, an overseas partner be sought to purchase equity in the business and be responsible for its overall management. As a first step towards this aim, the telecommunications division of the Ministry of Transport and Communications became self accounting in 1985.

In 1986 the government invited joint venture proposals from five large international carriers. Some companies sent representatives to Tarawa but no offers were made. The small size of the operation, the low traffic volumes and the difficult structural problems to be resolved were not an attractive proposition when compared to investment in other countries. However, OTC International took the view that if the operation could be suitably restructured under a two year management agreement, it would be prepared to reconsider its position on a joint venture at a later date.

Initially, the government rejected the management proposal due to some bad experiences with management agreements in other areas of government business. However, late in 1987, the government reconsidered its position and negotiations were resumed which led to the start of the management agreement on 1st April 1988. The agreement allowed the OTC International manager, who was to assume the title of Co-managing Director, a free hand in reorganising TKL.

AIMS OF THE MANAGEMENT CONTRACT

The management contract had the following main aims:

- to improve the profitability of Telecom Kiribati Ltd. (TKL) and lessen its need for annual government subsidies for operating losses.

- to restructure the company along business lines as it was acknowledged that this was the only way the government's goals of efficiency and profitably could be reached.

- to attract a future joint venture partner.

- to provide formal recommendations to the government for the long term development of telecommunications in Kiribati.

INITIAL ASSESSMENT

After my initial weeks in Tarawa it was apparent that my main task would be to change the structure of TKL and to develop a company culture that could deliver to the customers the improvements in service, service quality and efficiency that the modern digital exchanges and the satellite earth station were designed to provide. Employee trust and confidence would have to be developed to secure their support and to overcome the fear of change evident in many areas, especially the fear of losing their employment due to the "privatisation" of TKL.

Improved leadership and management were required if the necessary changes to the structure of the company were to succeed. A clear vision and purpose for TKL would have to be evolved by management and clearly communicated to the employees. This vision should incorporate the goals of improved service to customers and the achievement of a greater sense of achievement and personal worth for the staff through their employment. In particular the ideals of customer service and fair payment for good service required promotion and emphasis and channels of communication would have to be developed between management and staff to allow the consultation and to receive the feedback which is so vital to the success of any business.

Technical and service quality was in need of urgent improvement to satisfy customers needs and to ensure the financial security of the company. A fault or faults on Bairiki international gateway exchange which caused regular outages with a total loss of call billing data required urgent correction. International service was congested by a shortage of circuits and service quality was effected by severe echo and clipping. Faults in the local network (1,000 lines) were being reported at the rate of 150 per month and it was quite normal to rebate the monthly rental to subscribers because of long term faults. Investigation revealed that tools and the consumable items and equipment necessary to maintain and expand the network were not available. A review of staff numbers appeared necessary and I was particularly concerned with the safety of the staff, particularly the senior managers, who were transported to and from work in over-crowded company vehicles.

On the brighter side the company accounts were in excellent order. TKL had cash in the bank, had no significant debts and debt control was good. This cash coupled with the support of the Financial Controller would be crucial in the early months of the contract to fund and implement the initial service improvements.

Consultations with staff at all levels during those early months indicated a large number of capable people who were eager to support and actively participate in the reorganisation. It was equally apparent that there were many who were not capable of contributing to the new company and these people would have to be made redundant.

TKL FINANCIAL POSITION AT COMMENCEMENT OF THE CONTRACT

		1987 A$'000
Total Revenue		1,517.5
Expenditure	1,431	
Depreciation	748	
Total Expenditure		2,179
Loss before Subsidy		661.5
Subsidy		200
Loss for 1987		461.5

SPECIAL PROBLEMS FOR SMALL PACIFIC TELECOMMUNICATIONS ENTITIES

There are many specific problems faced by small organisations such as TKL. Some examples are :-

- small organisations need a core of capable multi-skilled staff as there is often insufficient work to fully occupy a specialist in his narrow field of expertise. Multi-skilled people are hard to find in this age of specialists and this is especially true of expatriates.

- when equipment is funded by aid, standardisation is almost impossible as equipment is selected by the donor on a project by project basis.

- training is difficult or alternatively very expensive if the equipment is not common in the Pacific.

- equipment suitable for small networks is becoming difficult to obtain as manufacturers concentrate on the more profitable needs of large companies in more developed countries. For example 2 - 12 channel VHF radio equipment and gateway exchanges suitable for small networks are in short supply.

- consumable supplies and spare parts are often difficult to locate, especially if the part is intended for equipment not common in the Pacific. In Kiribati I was able to purchase through the OTC Supply Division and this enabled many pieces of faulty equipment to be returned to service.

- high electricity charges. In 1988 TKL was operating a Standard B earth station with 5 international circuits and 3 small digital exchanges(total of 1,000 connected lines) for an electricity charge at 36 cents per kilowatt hour of A$270,000 per annum.

THE PLAN

As stated previously, the principal aim of the management contract was to convert TKL into a business with sufficient potential to attract a future joint venture partner. To achieve this in two years necessitated a high rate of change, and the changes contemplated had no precedent in Kiribati.

My first dilemma was to decide how much change the government would accept. Nobody was able or prepared to offer advice on this matter. I therefore decided on the hard option which was to aim for an ideal business structure for TKL and not to simply streamline the existing organisation.

My plan therefore was to make all necessary changes in the first two years with the ultimate goal of profitability in the third year.

To achieve this goal a number of objectives were planned and carried out in the following order:

1. Improve short term profitability to generate sufficient cash to finance structural change and improved service to customers.

2. Improve service quality.

3. Write a "Conditions of Service" for TKL - review salaries, allowances and conditions.

4. Develop urgent project proposals for aid funding.

5. Review service provided to Marine and Air Guard.

6. Review the Outer Islands HF Radio Service.

7. Introduce new revenue producing services.

8. Introduce IDD (International Direct Dial) to USA, Hawaii, Canada and 210 other destinations - stimulate IDD traffic.

9. Reduce staff numbers - review staff structure and relativities.

Improving short term profitability: In the first six months of the contract this was linked with improving service quality. TKL had to provide customers with a service that worked, a service with sufficient international circuits to carry the traffic and, when the calls were successfully completed, customers had to be correctly billed. The operation of Bairiki international exchange had been unsatisfactory since initial installation in 1986 due to hardware and software problems. Demands that the problems be corrected were made to the senior management of the manufacturer and this, coupled with assistance from the British High Commission and European Community aid officials, resulted in correction of most faults by the contractor"s staff in October 1988. In addition, the echo and clipping which was common on international calls was corrected by an OTC technical officer who corrected levels through the exchange and earth station and relocated the echo suppressors. Finally, the number of international circuits was increased from 4 to 7. In conjunction with the new circuits, overseas correspondents were notified that Kiribati now had adequate international circuits and requested them to make Kiribati an IDD destination. Due to the previous congestion many countries had made Kiribati a manual or operator only destination.

Conditions of Service. Review of salaries, allowances and conditions: Even though TKL had operated as a company for several years there was no separate "Conditions of Employment" for its staff. The government "National Conditions of Service", which TKL was using, had been written for the old British Colonial Service and was totally unsuitable for the company. A document was needed which would allow the sensible changes necessary to achieve a viable future for TKL. Urgent priority was therefore given to the writing of a draft "Conditions of Service for Telecom Kiribati LTD" which could be considered by the TKL Board before December 1988. The new document was based on an abbreviated version of the government conditions of service which was then modified to suit the needs of TKL. The draft also included provisions extracted from the employment conditions of many of the large telecommunications authorities in the region which were considered appropriate and affordable. The final document, written in simple direct English, was ready by October 1988 for consultation with staff representatives and the local union group.

The major benefit to staff of the new arrangements was large salary increases achieved mainly by cashing-out unnecessary benefits in kind. Due to the low profitability of the company, it was not possible to substantially increase salaries and allow staff to retain their traditional benefits. The proposed conditions were negotiated with an elected staff committee and the discussions were extremely cordial and constructive with the only point of contention being the value of the transport allowance. During these discussions emphasis was placed on the value of the new document as a means of setting the rules for management's dealings with staff. A comparison between the old and new conditions is given in figure 1.

The changes detailed in figure 1 resulted in a salary increase of almost 50% for lower paid staff and an increase of 20% in TKL's salary bill. However, overall staff costs were expected to reduce in 1990 due to planned staff reductions. Management's gain was a reduction in administration costs by converting benefits into cash. The reductions in leave entitlements allowed staff reductions in some areas and resulted in more time at work for highly trained staff.

Develop Projects for Aid Funding: Due to the long lead time of aid funded projects, it was necessary to begin planning for a series of projects necessary to improve future service and profitability and to realise the benefits of the planned domestic satellite system to be based on the PACT network. Projects were developed for a new Bairiki international telephone exchange with itemised billing and modern operator positions, a telephone exchange and cable distribution network for Kiritimati, expansion of the Tarawa exchange network, extension of the VHF radio network to the 6 islands adjacent to Tarawa, replacement of the Marine and Air Guard equipment and the incorporation of all HF radio transmitting equipment into a redeveloped site on Betio, Tarawa. This last measure will allow three separate transmitting sites to be closed down. Tenders for these projects were called in November 1990.

Marine Guard and Air Guard: Marine Guard provides a communications service for ships in Kiribati waters. Air Guard provides communications to the aviation industry and maintains navigational aids and beacons. When TKL was first formed, no provision was made to transfer these services back to the government, further increasing the company's operating loss. Therefore, on 1 January 1989, Air and Marine Guard Operations, including operators, were transferred back to the government, with TKL maintaining the service on a fee for service basis. This effectively converted an annual subsidy for loss into an income for providing a service.

Outer Islands High Frequency Radio Service: One look at the balance sheet was enough to indicate that major problems existed in this area.

Revenue:	$90,000
Expenditure:	$334,000
Depreciation:	$153,000
Operating Loss;	$397,000
Staff Employed:	43

This service is very important to residents of the outer islands of Kiribati and to the government ministries. This importance will remain until the service is superseded by the domestic satellite system. All government business, private business, social contacts and money transfers are made via the Outer Island Radio Service. The service could be substantially improved with new equipment but the proposed satellite service made this proposition impractical. A decision was therefore taken to improve the profitability of the service using the present equipment.

The major expense associated with this service was the salary and other costs of maintaining TKL radio operators on outer islands. These operators were provided because all telegrams and telegraphic money orders were traditionally sent over the system using morse code. As the actual work load of these operators was low, major savings could be made by transferring the operating duties to the staff of the local island council, who were also often under-utilised. However, the training of morse operators is long and expensive and it was decided that the transfer of operating duties could only be achieved by abolishing the use of morse code and sending all messages by voice. This would result in some loss of privacy but it was better to have this form of service than no service at all. The transfer of responsibilities was made on 1 January 1990 when the use of morse code was discontinued, resulting in the loss of 25 operating positions and expected cost savings of $100,000.

The new arrangements had some interesting benefits in addition to the savings in salaries and costs. These included:

- all telegrams being cleared by 12 noon on the day lodged.

- the freeing of frequencies formerly used for morse allowed more voice circuits to the outer islands.

New Revenue Producing Services: Tarawa is the perfect place to use a facsimile machine. It is very isolated, experiences regular and often lengthy interruptions to shipping, air and airmail services and has no local supplier of many of the basic items required for business or private use. The island, although only 100 metres wide in many places, is more than 40 kilometres long and business establishments are often far apart. However, in 1988 facsimile machines were not common due to a lack of appreciation of their uses, lack of local servicing and the high prices quoted by local agents.

TKL therefore introduced a facsimile leasing service in early 1989 with a guarantee of repair service within 24 hours. The two models offered are leased at a monthly rate which covers all costs with the exception of local and international call charges. The service has been a tremendous success with over 65 machines leased. It is estimated that the 40-60% increases in bothway international IDD traffic recorded in 1989/90 are directly attributable to the facsimile leasing service.

Reduce Staff Numbers and Review Staff Structure: TKL staff numbers were excessive when compared to operations of similar size in the Pacific. It was also apparent that many were not able to make a significant contribution to the new company. Another major problem was unequitable salary relativities in TKL due to salaries based on a public service clerical structure and where annual increments were paid regardless of merit or effort. One result of this was the salaries of several senior morse operators which were 30% higher than the earth station manager. A new staff structure with salary levels for each function based on training, qualifications and skill and with salary advancement based on annual assessment was produced. Unfortunately, this proposed structure was never considered by the TKL Board due to the joint venture negotiations, but it was used by management for the redundancy exercise.

With the higher salaries paid to staff, the company could not afford to carry unproductive people. There was also an urgent need to provide the tools and equipment needed by staff to do work efficiently and of acceptable quality. The high cost of providing these items was also a reason for reducing staff numbers.

Redundancy provisions which included a redundancy gratuity were incorporated into the new Conditions of Service. Staff were assessed in writing by at least two of their supervisors and each employee received a summary of their assessment. Initially, some staff objected to the assessments because they believed that they were being treated like school children. However, when it was explained to them that written or not written these were the comments on their work performance made by their supervisors, there was a general acceptance of the need for redundancy and the fairness of the selection process. Despite some questions in the Maneaba-ni-Mangatabu, the Kiribati Parliament, the first redundancy exercise in Kiribati was achieved, resulting in an overall staff reduction from 129 to 103.

Stimulate IDD Traffic - Introduction of IDD to USA, Hawaii, Canada and 210 other Destinations: The key to profitability in international networks is to stimulate IDD and to actively discourage operator traffic. This is a difficult task in an island nation as government departments control the use of the telephone by their staff by a blanket barring of IDD access. Trying to convince departmental heads of the benefits of IDD and more positive means of control was largely a waste of effort. It was also apparent that there would be little increase in IDD traffic to the USA at a tariff of $6.00 per minute. Therefore it was decided that from January 1990 the tariff for IDD calls would be reduced with operator rates held at current levels. This would pass on to IDD customers some of the benefits of IDD efficiency. A further surcharge of $5.00 per call was applied to particular person calls and a collect call surcharge of $5.00 per call was levied to reduce the losses experienced with this service.

1990 International Collection Rates

Destination	Operator per/min	IDD per/min
Band 1	$3.00	$2.75
Band 2	$6.00	$4.00

* Operator calls 3 minute mininum Charge

* Band 1 covers Australia, New Zealand, Pacific Islands excluding US territories
* Band 2 covers Rest of the World

The other factor necessary to stimulate IDD growth was a requirement for IDD to the USA, Hawaii and Canada, especially for facsimile calls. However, the Bairiki exchange with its limited international code discrimination facilities was not able to provide this service. To overcome this, arrangements were made with OTC Sydney to open up to TKL subscribers the 210 IDD destinations available to Australian customers. This was achieved by Sydney providing monthly IDD call data recorded on the Sydney-Kiribati route which is used by TKL to pay its overseas correspondents. The expanded IDD service coupled with the selective tariffing has been very successful in stimulating IDD traffic from Kiribati.

ACHIEVEMENTS OF THE MANAGEMENT CONTRACT

Some of the measurable achievements of the management contract are summarised in figure 2.

SPECIAL PROJECTS

There were several special projects which were undertaken during the term of the management agreement. The more important of these were:-

- installation of recovered HF radio and Lincompex equipment at Kiritimati and Tarawa to upgrade the quality of the service between the two islands. OTC International contributed $140,000 to the cost of this project which was requested in the management agreement.

- computerisation of the TKL accounts department. A decision was made to purchase three personal computers and associated hardware, software and furniture which had been on request to aid donors for many years. The ITU accounting package "TELMAN" has been installed along with a salary package and the increase in efficiency and the reduction in costs has justified the purchase many times over.

- the provision of communications for the 1989 South Pacific Forum Heads of Government Meeting in Tarawa

- the development and production of the Commercial Viability and Network Development Plan for Kiribati for the years 1990 - 2004

- the 1989 Kiribati Telephone Directory

1989 South Pacific Forum: This conference was held in Tarawa to coincide with the celebrations for the Kiribati 10th Anniversary of Independence on 12 July 1989. The meeting was attended by the Heads of State of all the Forum countries and senior officials of other countries with interests in the region. The communications network on Tarawa required urgent expansion to handle the telecommunications requirements of the conference. With a lead time of less than 8 months, a project was developed and implemented to expand Bairiki earth station from 10 to 15 international circuits, install a new IDD capable exchange in the Otintaai Hotel and to provide telephone, telex and facsimile services to the more than 50 journalists who covered the conference. One novel feature was the use of two OTC Satnet small dish satellite services to provide four 9,600 bits per second data circuits to Sydney for lap-top computers. These data circuits relieved at lot of pressure on the international telephone circuits during the week of the conference. TKL staff who manned the special media centre deservedly received many words of praise from grateful journalists. Temporary send and receive television link equipment was also installed and for the first time Kiribati faces and events were seen live on world television screens.

Commercial Viability and Network Development Plan: As part of the management agreement, OTC International had agreed to produce a plan for the development of telecommunications in Kiribati for the years 1990 to 2004. Due to the low per capita income in the country, the low population density and the large distance between islands, the planned PACT based satellite network is unlikely to be extremely profitable and the plan therefore has an emphasis on commercial viability. The plan, developed over a period of six months by OTC International in consultation with TKL, was presented to the Kiribati Government in October 1989. This plan has been approved as the blueprint for the development of telecommunications in Kiribati for the next 15 years.

1989 Kiribati Telephone Directory: A colourful and distinctive telephone directory is a great asset to a small country. As 1989 was the 10th Anniversary of Kiribati Independence, a decision was taken to produce the very colourful and distinctive 1989 directory which has become a collectors item for visitors to Kiribati.

FUTURE PLANS

The future of telecommunications in Kiribati is outlined in the Commercial Viability and Network Development Plan. The plan is being implemented by Telecom Services Kiribati Limited, a joint venture company with equity divided 51% Government and 49% OTC International. TSKL has an exclusive license to develop and operate communications in Kiribati until 2004.

The main emphasis will be to provide a fully automatic telephone network to all the populated outer islands of the country based on the PACT network. The plan calls for the installation of D1 earth stations with associated telephone exchanges on Kiritimati, Butaritari, Abemama, Tabiteuea North and Beru with traffic from neighbouring islands trunked in via VHF radio. Due to the long length and extreme narrowness of the islands, it will not be economically possible to provide an exclusive telephone service to every home. In the context of commercial viability a decision has been taken to provide sufficient cable on each island to provide service to at least 50% of its population.

The distribution of Radio Kiribati via the domestic satellite system will be an early priority of TSKL. This requirement is particularly necessary in the case of Kiritimati which is located 3,200 Km to the east of Tarawa. Residents of Kiritimati and the other islands in the Line Island group are extremely isolated and the provision of direct telephone and radio broadcast services will be greatly appreciated and will increase national unity.

The development and training of local staff to assume the key management and technical functions of TSKL is a key priority as the long term costs of expatriate labour will destroy any chance of profit for the joint venture partners. However, it has been agreed that localisation will only occur when the local candidate is of a sufficiently high calibre.

With the advent of local television in many Pacific countries, the Government of Kiribati is considering the possible future introduction of the service. Whilst the possibility of a local television service appears remote, the D1 earth stations planned for installation in Kiribati are specified with 7.5 metre dishes, the minimum diameter necessary for the reception of a good quality picture.

CONCLUSION

As a result of my experience as Co-Managing Director of TKL, I am confident that sensible changes to improve the service and profitability of small Pacific telecommunications authorities can be achieved. However, it must be recognised that in changing organisations such as TKL, corresponding changes must sometimes be made to the responsibilities or duties of other organisations such as government departments. Agreement to change is more easily achieved in the short term if the manager is employeed by a company with recognised expertise in telecommunications. In the longer term the expertise and management skills of the manager must be relied on and his ability to formulate and sell his plan for change must be backed up with measureable short term results. It was my experience that early agreement to any proposed change was more readily achieved if it was presented as a detailed written proposal which was well suited to the committee form of decision making often used in Kiribati. Finally, make full use of the local grapevine. Island communities are very small and local people are usually helpful and supportive if you advise them in an informal way of your plans and hopes for your organisation. Conversely, by becoming a careful listener at these informal meetings, valuable feedback can be gained on your proposals which will allow you to modify or change them to gain acceptance.

FIGURE 1

COMPARISON BETWEEN OLD AND NEW TKL STAFF SALARIES/BENEFITS

Benefit	Old	New	Increase in Salary
base salary			8%
annual leave	6 weeks	3 weeks	value of 3 weeks salary
sick leave	6 weeks	3 weeks	value of 1 weeks salary
annual leave fare to home island (value up to $975)	yes	no	total value of benefit divided by number of staff
free transport to/from work	yes	no	$4 per week

FIGURE 2

SOME MEASURABLE ACHIEVEMENTS OF THE MANAGEMENT CONTRACT

	A$'000			
	1987	1988	1989	1990
Total Revenue	1517.5	1746.5	2376.5	2700
Expenditure	1431	1413	1724	1717
Depreciation	748	725	745	876
Management Fee	0	94	125	125
Redundancy	0	0	35.5	12
Total Expenditure	2179	2232	2629.5	2730
Loss before Subsidy	661.5	485.5	253	30
Subsidy	200	250	122	123
Loss for Year	461.5	235.5	131	(93)
Staff numbers	129	129	124	102
Inter. Circuits	4	7	12	15
IDD Penetration %				
In	6	60	84	82
Out	30	33	50	57

* The 1990 results are estimates based on half-year results

POLICY CHANGES AND TECHNOLOGY INNOVATIONS IN CHILE.

ITS CONSEQUENCE ON TELECOMMUNICATIONS GROWTH.

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1. Abstract

This paper describes the current changes in chilean telecommunication sector as a result of recent privatization of Compañia de Teléfonos de Chile (CTC) property. It give an overall view of Chile's economy, the current situation of the economical and social policies, operators structure, latest telecommunications regulation and tariff laws, and the recent CTC's privatization. These major changes are providing CTC the legal and economical means to install sufficient telephone lines to overcome the existing disattended demand gap and has strengthened the execution of the medium term program (1991-1996) that will fulfill the user needs. Moreover has allowed and opened in CTC's perspectives to be abreast with the technological innovations and enter into new telecommunications businesses and other new technologies.

2. Introduction

Compañia de Teléfonos de Chile S.A. ("CTC") is the largest telecommunications enterprise in Chile, owning approximately 94% of all telephone lines in the country. The Company's principal business is providing local telephone services to 77% of the national territory where 92% of Chile population resides.

The Company provides local public telephony throughout continental Chile except in two regions located in southern Chile. Additionally, the Company operates a cellular telephone network in each of the two principal metropolitan areas of Chile, Santiago and Valparaíso, where approximately 50% of Chile's population is concentrated.

3. Historical Background

Telephony in Chile commenced in 1880, with the formation of Compañia de Teléfonos de Edison, in Valparaíso. In 1927, the International Telephone and Telegraph Corporation ("ITT") acquired the Chile Telephone Company, which had 26,205 telephones in operation at the time. In 1930, the Compania de Teléfonos de Chile S.A. was formed as a stock company. In 1971, the Chilean Government intervened to take management control of the Company and in 1974, the Corporación de Fomento de la Producción (Corporation for the Promotion of Production "CORFO") acquired 80% of the total shares issued by CTC, which were then held by ITT Sudamerica. CTC thereby became a state-owned company subject to private law in which a government corporation contributes the majority of capital. In 1988, CTC was privatized again by selling CORFO's shares at international bidding (refer heading "CTC privatization).

4. Overview of Chile's Economy

Chile is a narrow strip of land that occupies the western coast of southern South America with a population of approximately 13 million.

Chile is definitely an exception for Latin America and serves as the role model in economic policy for many other Latin American countries. Chile has successfully pursued an open economy reduction of the state apparatus and development of the domestic capital markets.

Chile's healthy economy has attracted significant foreign investments in diverse industry segments that include the manufacturing and service sectors as well as the traditional raw-materials-based segments. Foreign investment in 1989 totaled approximately US$ 1.6 billion.

A disciplined fiscal management and the consistent application of free market policies have produced economic growth, stability and improved social welfare.

Chile's clearly defined and well-executed privatization program has been not only a success but more importantly forms the base in the transformation of Chile into a well-diversified market-driven economy.

A policy of the Chilean government has been to reduce the size of the state in the economy. During the years 1985 - 1989 emphasis has been put in privatizing state-controlled companies. Several sales procedures have been implemented, such as international competitive bids, auctions or sales of stocks or shares at the stock exchange market, transfers to workers employed in the companies and sales to institutional investors. Some 30 companies, including CTC, were completely or partially privatized. Sales through CORFO raised the equivalent to US $ 1.2 billions.

From 1977 to 1989, Chile's domestic gross product (DGP) growth was 63,4%, that averaged to 4.2% annual growth. The telecommunication sector growth was 231.5% in the same period, which means an annual growth of 10.5%. Refer to Figure 1. The growth during 1987 and 1989 when CTC was privatized the telecommunication sector annual rate growth was 15.1%, very high compared with that obtained by DGP 8.7% annual rate.

Chile has maintained a large trade surplus that amounted to approximately US$ 1.6 billion in 1989 and at the mid of 1990 the accumulated trade surplus amounted to US$ 746 million. It is the government's intention to continue to stimulate exports and seek out additional foreign investment during these coming year. Refer to Figure 2.

Despite the doubling of the world copper price in 1987, Chile has reduced its dependence on copper by developing its agriculture and fishing productions.

The economy is based on a diversified export base which produced US $ 8 billion in hard currency in 1989. This represents approximately 30 percent of GDP. Agriculture, fishing and industrial sectors have led export growth, allowing for a reduction of the dependency on copper-generated income. This broad-based diversification is expected to continue in the years to come. Refer to Figure 3.

The Chilean economy grew 10 percent in 1989, up substantially from the 7.4 percent registered in 1988, as a result of expansionary fiscal, monetary and exchange rate policies. Unemployment has been reduced with the continuing expansion of the economy, from 12 percent in 1985, to 5.3 percent in 1989 and the estimate for 1990 is 6 percent.

In addition, coherent macroeconomic and monetary management have kept inflation at a relatively low rate during past years. Excessive expansionary polices carried out during 1988 and 1989 resulted in higher levels of inflation during 1989 (21.4%). The present government is trying to cool down an overheated economy through high interest rates, and this appears to be working. Moreover, the present Irak-Kuwait international political affair and the resultant world petroleum crisis is also seriously distorting the chilean economic stability.

In an effort to reduce inflation, slow demand and take liquidity out of the economy the newly independent Central Bank raised interest rates in January 1990. This interest rate hike led investors to move out of dollars into more attractive pesos, which led to a small revaluation of the currency.

The government has reduced Chile's external debt burden to approximately US$16.3 billion in 1989. Foreign debt in 1990 is expected to decrease to approximately US$ 15.5 billion because of an increasing number of these conversions.

5. CTC Privatization

As mentioned before, to obtain a well diversified national market-driven economy, the privatization policy was also applied for telecommunications.

Within less than two years the chilean telecommunications main operators, CTC and ENTEL (refer heading "Operators Structure"), has moved from State ownership and monopoly situations to private sector control and competition, giving the necessary impulse and resources for the telecommunication sector development.

In August 1987, CORFO announced it would reduce its shareholdings and privatize CTC by selling approximately 30% of CORFO's CTC Shares, pursuant to an international open bid and simultanously almost double the capital through the emission of 90 percent of new shares. The specifications for the bid included a commitment by the bidder to subscribe to its proportional interest in a capital increase of a number of additional shares. Bond Corporation an australian financial enterprise ("Bond Chile") offered the highest weighted price for both the CORFO and the committed Shares.

Bond paid shares subscribed in CTC rights issue that took the corporation's shareholding from 32 percent to 50.2 percent. This was the largest direct investment in one payment ever to occur in Chile. Under CTC's Bylaws no shareholder normally may own more than 45% of the Company's subscribed Shares but an agreement has been made under which Bond Chile will reduce its share ownership to 45% by October 1992. In April 1990, a subsidiary of Telefónica de España acquired the stock of Bond Chile and hence all of Bond Chile's interest in CTC. Furthermore on July 1990, CTC obtained from Securities and Exchange Commission (SEC) approval to sell CTC's shares internationally at the New York Stock Exchange, and upon the consummation of the international offering of American Depositary Receipt (ADR) that represents approximately 12% of CTC Shares, Telefónica Chile's ownership was reduced to 42.6% (Refer to Figure 4).

6. Operators Structure

Telecommunications services in Chile are provided by seven operators. The two majors operators are ENTEL, a privatized operator that provides international telephone services and most of the long distance internal transmission and CTC that controls approximately 94% of the local telephone service in the country. Five small companies currently also provide local service, two of which operate within CTC's concession area. These two companies together account for approximately 2% of the total telephone lines in service in Chile. Three companies operate in Regions X and XI in southern Chile, where CTC has not been granted a concession.

With respect to long distance services, CTC, through a subsidiary, has applied for concessions to develop and operate its own fiber optic networks and satellite links which would ultimately allow the Company to provide all of its concession areas with domestic long distance services through its own equipment. According to the decision of the Resolutory Commission of the Fair Trade Enforcement Commission, if such concessions were awarded to CTC, the user would choose between CTC, ENTEL and other providers under such a multicarrier system both in terms of price and technology. Even if CTC is not awarded the concessions, its current domestic long distance concessions are expected to continue in force and its international long distance interconnection service would also continue to operate.

Regarding cellular telephony, CTC has only one principal competitor, CIDCOM. While CIDCOM is oriented principally to mobile rather than portable cellular telephone and to more high-powered cellular equipment, CTC is oriented towards a network configuration capable of providing wider coverage through low-powered portable sets.

Regarding CTC's services which complement basic telephony, such as facsimile and data transmission, there are various domestic and international competitors. CTC competes in such markets on the basis of its institutional presence throughout the country, its service and maintenance capabilities and on the basis of price.

7. Telecommunication Regulation

The Ministry of Transport and Telecommunications' Undersecretary of Telecommunications regulates all telecommunications systems in Chile although its role is essentially technical and includes the allocation of radio frequencies.

The provision and operation of telecommunications services, systems and equipment in Chile are principally regulated by the Telecommunications Law (1982) and Law D.F.L. Nº 1 (1987) that specifies, which telecommunications services require a concession or permit, from the Undersecretary of Telecommunications. Among services requiring a concession are (i) public services-those provided for the needs of the community; (ii) intermediate services-those long distance transports provided between cities and (iii) limited services-those encompassing private telecommunications networks for business and institutional users.

The emphasis of the latest Telecommunications Law was in offering a business profitable enough to attract national and foreign investors and induce them to make the very large investment required.

Public Telephone Service concessions, which may be granted to an individual or an institution, specify the conditions which the concession holder must fulfill in order to install and operate the service that is the subject of the concession. Concessions may be valid for a fixed period or may extend indefinitely and may apply only within a specified geographic area. By virtue of receiving the concession, its holder is obligated after a specified period of time to provide services of appropriate quality to all parties requesting the service in the geographic area of the concession, which after such period of time becomes the "compulsory service area". A concession holder must also provide service to those parties that although situated outside any compulsory service area are willing to pay the cost of the extensions needed to provide services to them.

Concession holders may demand from a person wishing to become a subscriber of its services, or from an existing subscriber wishing to have additional telecommunication facilities, a reimbursable advance contribution toward the cost of providing the service requested. This advance payment may be reimbursed by the concession holder by the delivery of shares, bonds or by such other means as may be agreed upon. CTC's current policy is not to make reimbursements in shares or in bonds, although reimbursements in shares and bonds have been made in the past.

Under the terms of the grant of its concessions, CTC has 10 years (until 1997) to integrate into its local telephone system the various localities within its geographic concession areas. CTC has published a calendar which sets forth the schedule for such integration on a year-by-year basis. Once the respective date for a locality's integration occurs, that locality becomes part of CTC's compulsory service area and CTC within the next succeeding three years is obligated to provide services to all applicants for local service in that locality.

CTC and other concession holders of the same telecommunication public services are required to effect interconnections between them as are required to ensure the availability of public services to all users and the continuity and compatibility of the country's telephone network according to the standards issued by the Undersecretary of Telecommunications.

8. Tariff System

The Chilean telecommunications law generally provides that prices for telecomunications services should be established by market forces. Nonetheless, if the Chilean commission charged with assuring free market conditions in various sectors of the Chilean economy (the "Fair Trade Enforcement Office") determines that conditions in a given sector of the telecommunications industry distort the operation of market forces, prices and tariffs in that sector will be regulated. The Fair Trade Enforcement Office has determined that conditions prevailing in the local and domestic and international long distance telephone services markets and in the market for certain intermediate and other services are not conducive to the free and fair determination of prices, thereby these services are subject to tariff regulations. Currently, tariffs for the rest of the services provided by CTC, including cellular and public telephones, are determined by market conditions. Tariffs for the regulated services are determined by applying an economic model that is based on certain assumptions as to cost, efficiency and growth of a hypothetical company providing regulated services and on a rate of return commensurate with the providing company's assumed cost of capital. For 1989, services subject to tariff regulations accounted for approximately 80% of CTC's operating revenues (54% from local services and 26% from long distance services). The balance of such revenues derived from services not currently subject to tariff regulations.

The detailed procedures to determine tariffs for the regulated sectors of the telecommunications industry are the following:

Under the tariff-fixing process, which by law takes place every five years, the concession holder based on an economic and technical framework agreed with the Undersecretary of Telecommunications, prepares a study for each regulated service included in its geographic concession areas. The purpose of the study is to calculate the incremental development and marginal costs with respect to each such service, and to determine on the basis of such calculation the structure and level of tariffs. The study and specific tariff proposals are submitted by the concession holder to the Ministry of Transport and Telecommunications and to the Ministry of Economy, Development and Reconstruction.

While the tariffs specified in the tariff decree are maximum tariffs, service providers cannot discriminate among users of the same service within a concession area. All tariffs are adjusted for inflation upon notice to the Undersecretary of Telecommunications according to a costs index included in the tariff structure. There is a different indexing mechanism for each regulated service so as to reflect the different theoretical cost components associated with each individual service subject to tariff regulation.

Traditionally, domestic long distance telephone service has subsidized local service. The subsidy is provided by a surcharge on each long distance telephone call. As indicated below, however, the subsidy is being gradually eliminated as tariffs for local services are increasing and tariffs for domestic long distance services are decreasing. After 1993, CTC will only be permitted to charge a price for installation of telephone lines based on the actual costs of installation.

Executive decrees published in Chile's Official Gazette on January 4, 1989 established the tariffs CTC can charge its customers until December 31, 1993. The following tabular presentation sets forth tariff information expressed as percentages of CTC's charges as of September 1, 1989 for each of CTC's regulated services. (Refer to Figure 5).

The economic model underlying such tariff structure is bassed in part on a development study submitted by CTC to the Undersecretary of Telecommunications. The practical effect of the present tariff structure as it applies to CTC is to provide an incentive to (i) accelerate the installation of lines in service, and (ii) reduce its operating costs thereby outperforming the performance assumptions underlying the study on which the tariff structure is determined, and consequently increase its actual profitability.

The existing tariffs for the Company's regulated services expire on December 31, 1993, although the present Government may seek to revise the current tariff decrees prior to such date. Further, certain services not currently subject to tariff regulation may by executive decree become subject to tariff regulation if the Fair Trade Enforcement Office determines, in accordance with the telecommunications law, that conditions in the relevant sector distort the operation of market forces. CTC's tariff structure can be revised and services not currently subject to tariff regulation can become regulated only after the tariff-fixing procedures discussed above have been complied with.

9. **Legal Proceeding**

Prior to the privatization of CTC and ENTEL in 1988 and after their privatization, ENTEL has provided transmission medium for domestic (with certain exceptions) and international long-distance transmission services in Chile, while CTC (with certain exceptions) in their concession areas has provided all the local telephone networks and the long distance service between the Chile's two largest cities (Santiago and Valparaiso).

As part of its plan to expand its domestic long-distance telephone services, the Company applied to the Undersecretary of Telecommunications through an essentially wholly owned subsidiary (CTC-Transmisiones Regionales S.A.), for a concession to provide intermediate domestic long distance services through satellite links and fiber optics cable system. ENTEL formally objected to CTC's applications, alleging that the requested concessions would place CTC in a monopolistic position in the telecommunications business. CTC responded, in essence, that its applications were based on the Chilean Government's objective of open competition in all sectors of the telecommunications industry and that CTC would expand the telephone service and introduce advanced technology into the sector.

The Undersecretary of Telecommunications attempted to mediate a negotiated settlement between CTC and ENTEL. No agreement, however, was reached and the Undersecretary of Telecommunications referred the matter of CTC's applications for the concessions to the Fair Trade Enforcement Office to obtain a determination as to the consequences of CTC's proposed vertical integration within the telecommunications industry (local and long distance network). The Fair Trade Enforcement Office was required to respond to two specific questions: (i) in what way would free competition be affected by the vertical integration of the telecommunications industry; and (ii) whether the local and long distance services can be considered as different markets and whether local companies should be prevented from participating in the long-distance sector.

The final decision is still pending, being CTC's expected favorable court resolution the following:

The local companies could enter the long distance market and long distance companies could enter the local service market, complying with the following: (i) the company entering the new sector creates a subsidiary to provide services to the new sector (to identify transfer costs) and (ii) in the case of local companies, the local company modifies its system (at its expense) so as to provide interconnection with all long-distance carriers through a multicarrier system.

10. Basic Telephone Services

Basic telephone services include local as well as domestic and international long distance telephone services. These services accounted for approximately 80% of CTC's total operating revenues for 1989. The following steps forth information regarding the development of CTC's basic telephony business.

Of the 795,000 lines in service at December, 1990, approximately 73% are residential, 24% are business, 2% are public telephone lines, and 1% are principally lines for CTC's own internal traffic administration use. At March 31, 1990, CTC had a total of 259 telephone exchanges: 51 manual and 208 automatic, 99.5% of all of CTC's lines then installed were connected to automatic exchanges.

Despide the growth in CTC's telephone system in recent years, the number of lines per 100 inhabitants in Chile was only approximately 6.5 at December, 1990. CTC's development plan objective is to double this value at the end of 1996. In comparison, the United States, Argentina, Mexico, Brazil and Venezuela had approximately 52, 10, five, six and eight lines per 100 inhabitants as of December 31, 1987, according to the International Telecommunications Union's Yearbook of Common Carrier Telecommunications Statistics, 1989.

Local Services. At December 31, 1989 and March 31, 1990, revenues from the Company's local service represented approximately 54% of total operating revenues. Local service revenues include charges to subscribers for installation and proceeds from sales of rights to telephone lines (14.0% of total operating revenues in 1989). Under the current tariff structure, as earlier noted, the ability of CTC to charge for the sale of rights to telephone lines is scheduled to be eliminated by the end of 1993. Such tariff structure, however, increases charges for local service through 1993 as said under the heading "-Tariff System".

From 1985 through 1989, CTC's local telephone traffic has sustained an annual compound rate of growth measured in the number of calls (but excluding calls made from public telephones and calls made under the "flat fee" charge system) of 7.2%.

During the first quarter of 1990, 832 new private lines were leased, increasing their total number to 16,242. Additionally, 476 private exchanges and multiline systems equipment and 50,256 telephone sets were sold during such quarter.

Other services. CTC is developing other telecommunications services not currently subject to tariff regulation, including data transmission, facsimile services (including "telefax" and "publifax"), information services (including time and temperature services), supplementary services (such as call-forwarding and call-waiting) and consulting services (including technical assistance to large organizations in the design, engineering and development of telecommunications systems). Such services have been only recently implemented and several are only in a test-marketing stage of development.

11. Technological innovations.

Within telecommunication enhancement one of the main objectives of the Company is to develop the existing telephone and telecommunication network into a digital based system. In 1983, CTC began with the installation of 180,000 lines, the first digitalization program in three main cities, in each conforming a digital plane (network), paralell to the existing analog plane, both interconnected by PCM links. With 200,000 digital lines installed during 1990 for expansion and automation projects, the Company achieved an installed capacity of 620,000 lines at the year-end, and automation and digitalization of 99.6 percent and 63 percent, respectively. Through the expansion program 1991 - 96 the installation of approximately 870,000 digital lineas will give 84 percent digitalization of CTC's network with 1,500,000 installed digital lines. Such a digital system would permit simultaneous voice, data, text and image transmission and more efficient utilization and maintenance of the network through automatically managed testing and traffic control. The continuing modernization and enhancement of digital switching and transmission equipments and the implementations of the common channel signalling Nº 7 (CTC signalling plan : completed at end of 1993 its introduction in the digital networks according to CCITT Blue Book), are designed to permit the development of intelligent network and integrated services digital network (ISDN), in CTC digital networks.

12. Development Plan

In order to reduce significantly the existing unsatisfied demand for telephone lines, the Company adopted a Development Plan 1991-1996 which targets and additional 830,000 lines in service by the end of 1996, to reach a total of 1,623,000 lines in service by such date. As initially adopted after the privatization of CTC in 1988, the Plan targeted a total of 1,200,000 telephone lines in service by December 31, 1992. By the end of 1989, management had identified various potential obstacles to the full and successful implementation of the Plan, including the possible lack of availability of outside contractors, and possible delays or shortfalls in financing for the Plan.

Subsequent to Company's re-evaluations and to the acquisition of control of CTC by Telefónica Chile, the Company has revised and extended its Development Plan (from 1992 to 1996) to provide for an annual growth rate of 15 percent at which lines are placed in service, more commensurate with the operational capabilities of the Company. (Refer to Figure 6).

The Plan targeted the placement of approximately 1,000,000 lines in service for the period 1990 through 1996 with eighty percent increment, and approximately 16 telephones per 100 inhabitants by the close of 1996, obtaining a full automation of CTC's networks.The investment during this period amounted to US $ 1,000 million corresponding to line installations and US $ 90 million to long distance equipments.

13. Conclusion

In summary the characteristics of CTC as a private telecommunication company, offer a substancial better opportunity for the expansion and development of the telecommunication sector. As outlined in this paper, the privatization of CTC (refer to section 5), the economic and political situation that are currently favorables (refer to section 4), the digital technology qualities that allows for the penetrations of new products and services, and their applications as major steps are giving the solutions towards better domestic telecommunication networks. Also has made CTC to make breakthroughs in its development, the initial breakthrough being the setting up of the new six year development program that will double the current 795,000 telephone lines in service.

One of the esencial results of the CTC privatization is the posibilities as private company of obtaining new financial resources e.i. suppliers foreign credits, greater investment profit distribution, ADR offering internationally, etc., that results favorable for telecommunication sector development, by bypassing the legal and regulatory impediments for state owned company.

The current basic telephone services are considered monopolistic which requires regulated tariffs. These are fixed through DFL 1 Law (1987) and applied as explained in section 8. CTC current government approved regulated tariff projection valid from the beginning of 1990, are the adjustment given in Figure 5 valid for five year period (1989-1993), with bimonthly inflation correction, calculated considering an economical model that is based on costs, efficiency and growth of the company providing regulated basic services.

Moreover experience gained during this last three years of privatization has shown that the approaches effectively implemented, can provide important benefits to both CTC (service providers) and users in this sector. In fact, from December 1987 up today, CTC installed lines capacity has increased in 53 percent, with 17% average annual rate and the present 8.6 telephones per 100 inhabitants, being 6.7 for 1987.

The role of CTC as the major telecommunication company increases with each passing year, and has proved to be an effective agent for the introduction of new services and technological innovations in the sector. At the end of 1996, the total lines in service will double the current situation, resulting 1,623,000 lines in service with 1,360,000 digital lines reaching 84 percent of digitalization, and fulfilled the introduction of ISDN telecommunication services throughout CTC concession areas. As network and service suppliers CTC has extended and will mantain their responsabilities in a global manner about opportunity and quality of service offered to the users.

FIGURE 1

CHILE - GROSS DOMESTIC PRODUCT:
TOTAL AND COMMUNICATIONS SECTOR
ANNUAL VARIATION (%)

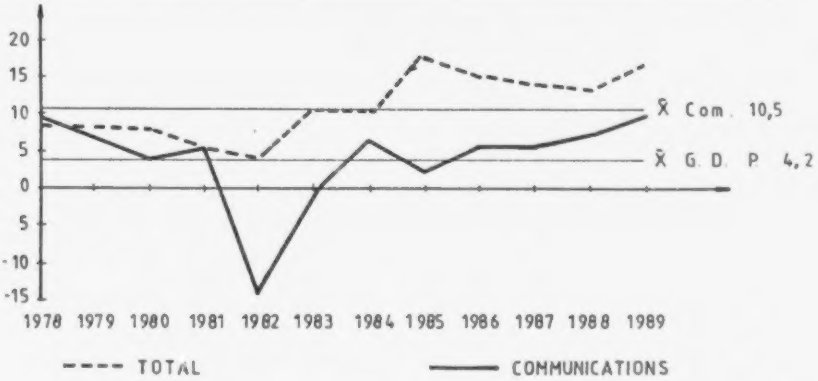

FIGURE 2

CHILE: TRADE BALANCE OF GOODS

YEAR	1985	1986	1987	1988	1989	1990
US $ MILLIONS	849	1,100	1,229	2,219	1,578	1,500

FIGURE 3

Chile: Export Sectors
1989

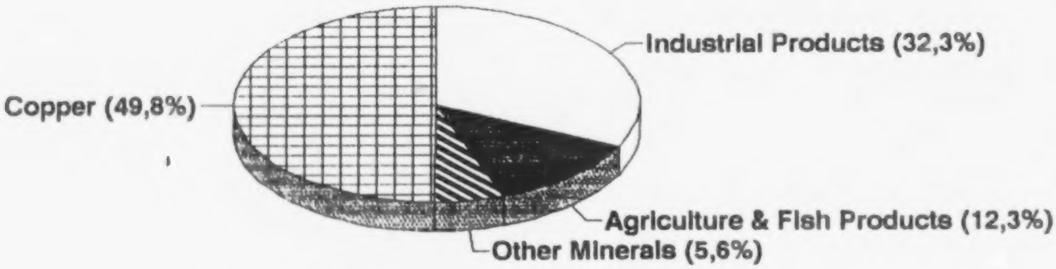

FIGURE 4

SHAREHOLDER OWNERSHIP EVOLUTION

	PERCENTAGE				
	1978	1987	1988	1989	SEPT 1990
STATE OWNED	87.5	61.0	12.1	2.5	0.1
SINGLE OWNED PRIVATE HOLDER	-	1.5	42.6	42.6	42.6
OTHER PRIVATE HOLDERS	6.6	18.9	30.2	41.4	43.1
UNSUBSCRIBER SHARES	5.9	18.6	15.1	13.5	0.6
THE BANK OF NEW YORK (ADR)	-	-	-	-	13.6

FIGURE 5

TELEPHONE SERVICE TARIFF INFORMATION EXPRESSED AS PERCENTAGE OF CHARGES

	1989 SEPT	1990	1991	1992	1993
LOCAL TELEPHONE SERVICES					
"PER CALL" CHARGE SYSTEM					
FIXED MONTHLY SUSBSCRIBER'S FEE	100	123	138	154	171
PER CALL CHARGE	100	100	100	100	100
"FLAT FEE" CHARGE SYSTEM	100	114	125	136	147
SALE OF RIGHTS TO TELEPHONE LINES	100	62	25	12	0
DOMESTIC LONG DISTANCE SERVICES	100	80	74	65	65
INTERNATIONAL LONG DISTANCE SERVICES	100	100	100	100	100

FIGURE 6

PUBLIC TELEPHONE DEVELOPMENT PLAN 1990 - 1996 PERIOD

	1990	1991	1994	1996	PERCENT INCREASE 1990-1996
NUMBER OF LINES INSTALLED	979	1,122	1,593	1,762	80.0
LINES IN SERVICE	795	943	1,413	1,623	104.2
AUTOMATION (%)	99.6	99.8	100	100	0.4
DIGITALIZATION (%)	63.3	68.7	81.5	84.1	20.8
TELEPHONES PER 100 INHABITANTS	8.6	9.9	14.1	15.8	83.2
NUMBER OF TELEPHONES	1,058	1,235	1,851	2,126	101.0
APPLICATIONS PENDING	401	342	100	0	

X.25 REVISITED:

NEW USES FOR AN OLD PROTOCOL

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1. ABSTRACT

X.25 packet switched networks are well-established carrier media for a wide range of public-access information and communications services. Casual observers of such services might conclude that X.25 networks are severely limited in their ability to handle high-volume, high-speed traffic. In fact there are no such technical limitations. For the vast majority of network users, X.25 operations are "transparent" even at bandwidths of 56 kilobytes and more. X.25 networks can carry impressively high-speed bulk file transfers, graphic images and interactive transactions that include graphics. X.25 is only now coming into its own.

2. A REVIEW OF X.25 HISTORY

X.25 packet-switched network systems were conceived and designed in an era when computers were expensive and data processing was under tight centralized control. None of us realized it at the time, but we were operating in a paradigm that was defined more by economics than by technology. Consider these design constraints:

[FIGURE #1]

- Computers were so expensive that their cost was the driving force behind network design.

- Terminals were similarly expensive. Thus, the prohibitive cost of computing power forced those early work stations to be *dumb*, a term that implied an absence of any local processing capability.

- Those two facts taken together led to a network environment we now describe as Master/Slave. The network had only a single computer and it had to do everything. In addition to whatever processing tasks were on the agenda, the computer also acted as a traffic cop on the network and a data flow controller. That's why we referred to remote stations as *terminals*; they were little more than distant extensions of the host computer. A terminal was a place where the process came to an end.

- Finally, data transmission speeds had a practical upper limit of about 9,600 bits per second. That was as fast as you could push data over the existing telephone network.

In retrospect, it seems remarkable that X.25 packet switching incorporated so many capabilities we could exploit as technology and economics marched ever onward.

[FIGURE #2]

Even the earliest implementations of X.25 provided Peer-to-Peer communications (in sharp contrast to the existing practice of Master/Slave,) inherent error correction, multiplexing (so that multiple sessions could use the same physical line,) transparent traffic routing and speed conversion. Back in 1978 it wasn't so clear that any given station on the network might be capable of local processing, and it was similarly unclear that one of the stations might usefully communicate with another station, bypassing the so-called *host* computer. Even so, X.25 provided that capability.

There was no reason for early users of packet switched networks to think about the broader capabilities of X.25. They were doing their best with the economic constraints of the time, and they just naturally associated their data processing limitations with their *assumed* limitations of the network. That early paradigm no longer applies to packet switching, but millions of potential users overlook this powerful medium because of that erroneous association.

The years since 1978 have seen several technological breakthroughs that make packet switching more useful than ever:

[FIGURE #3]

- Inexpensive microprocessors and their associated memory and disk storage devices have just about done away with economic limitations on the distribution of computing power.

- Digital transmission lines now provide bandwidths up around 2 megabits per second.

- Competition has driven down the cost of data transmission to the point where it is as much a part of the normal business environment as any other form of communication.

And now we have full-power computing stations everywhere. Minicomputers and PCs are everywhere. There has been a migration to many types of digital services that were once considered exotic, or didn't even exist. We have FAX machines in countless offices and even in our homes; we have LANs in small businesses; we have automatic teller machines linked in nationwide networks; we have point-of-sale systems that are integrated with management and control functions that once seemed impossible to implement.

We have distributed information data bases and services. And users have unlimited access to graphic or image interfaces as realized in PC graphics, FAX transmissions, CAD/CAM work, image processing, etc.

It is certainly true that packet switching arose during a limited time, but packet switching was never a limited concept. X.25 has exhibited an almost-uncanny ability to grow with the times and accommodate the changing needs of the data communications community.

3. HOW X.25 WORKS

[FIGURE #4]

Contemporary packet switching is easy to understand. In a packet switched network, the originating station establishes contact with another station on the network by dialing a series of digits.

As soon as the contact is made, the originating station automatically requests that the ensuing transactions use the maximum packet size for which it is configured. Packets can be any binary size between one byte and 4 kilobytes, but different terminals have

THE MID-'70s PARADIGM:
ECONOMICS-DRIVEN

- EXPENSIVE COMPUTERS
- EXPENSIVE TERMINALS
  (DUMB TERMINALS)
- MASTER/SLAVE NETWORKS
- MAX. DATA SPEED = 9600 bps

FIG. 1

THE X.25 BREAKTHROUGH:
AN UNEXPLOITED NETWORK

- PEER-TO-PEER
- INHERENT ERROR CORRECTION
- TRUE MULTIPLEXING
- TRANSPARENT TRAFFIC ROUTING
- DATA SPEED CONVERSION

FIG. 2

THE '90s PARADIGM:
A NEW ENVIRONMENT FOR AN OLD NETWORK

- INEXPENSIVE MICROPROCESSORS
- INEXPENSIVE MEMORY
- HIGH SPEED LINES: 2 mbps
- COMPETITION-DRIVEN DATA TRANSMISSION COSTS

FIG. 3

AN X.25 NETWORK

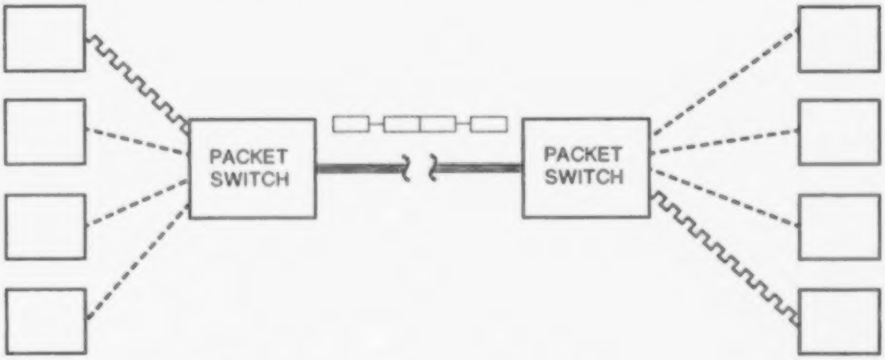

PACKET SWITCH
PACKET SWITCH

FIG. 4

different capabilities. The two stations exchange signals automatically until they determine the maximum packet size both can accommodate. In simpler systems, the default packet size is 128 bytes. The handshaking routine is so rapid that the human operators don't notice a significant time lapse.

[FIGURE #5]

Now the data exchange is initiated. The originating device simply lets the data flow into a register of the transaction-determined byte capacity, calls it a *packet*, adds an address to the header and an error correction segment to the trailer, and shoots the packet out over the broadband network.

Somewhere else on the network another packet switch recognizes the address, sends that particular packet to the correct destination, and the packet of bytes flows into the target terminal.

The network carrier is so broadband that it can accommodate a great many packets destined for a variety of different addresses. And the inherent transmission speed of the network carrier is so much greater than the terminal device response speed that this *packetizing* of the data stream is not perceptible as an interrupted data flow.

[FIGURE #6]

The packet switches serving each point of presence have counters built in to measure the data volume of each transaction. This count is translated into units of 64,000 bytes each, called *Kilosegments*. Packet switched network tariffs are based on a fixed price per kilosegment transmitted.

4. ECONOMICS

Having mentioned *price*, a word or two about the economics of packet switched data communications seems in order.

There are organizations that must maintain constant on-line data communications, and those organizations are best served by using full-time leased circuits. Private lines make sense when traffic volume is at least 40 megabytes per day.

[FIGURE #7]

At the other end of the spectrum there are many casual users of data communications who need only a few minutes of service per day. Those users employ the public switched network and go through conventional telephone modems. It isn't easy to define a casual user of data communications, but we use an upper limit of 1 megabyte per day as our general guideline.

The vast area between those two extremes is the happy hunting ground of packet switched network service providers.

As an aside, I will tell you that my company's largest cluster of customers are those organizations with minicomputers in scattered locations, where the major applications are distributed computing and shared business information. Those users typically exchange about 10 megabytes of information per day, and their computing equipment is the equivalent of an IBM AS-400, or a system made by H-P, Tandem or DEC.

I introduced the word *kilosegment* a little earlier, and I realize that many people are unaccustomed to thinking about data communications tasks in terms of kilosegments. Here are a few translations taken from familiar tasks..

[FIGURE #8]

Two pages of conventional documents transmitted over a FAX machine amount to about one kilosegment. If you take twenty cents as the price of transmitting a kilosegment, then FAX documents run about ten cents a page. Regardless of the time it takes to move the information. Remember, we're charging by the kilosegment, not by the minute. The FEDEX.25 network and most other packet switched networks also assess a duration charge, but it is a small component of the overall communications cost.

A full 360K floppy disk from a personal computer holds about 6 kilosegments of data, and would take about 10 minutes to transmit over a telephone line with a 1200 bps modem. If the phone call runs 30 cents a minute, that's a $3 call. As a packet switched transaction it would cost around $1.20 plus the duration charge.

If, by some chance, you had a 10-meg file on a hard drive (not so unreasonable in these days of widespread data bases) and you tried to transmit it over the phone lines at 9600 bps, you'd be on the line for around 180 minutes at a cost of roughly $54. If you sent it through a packet switch at 56 kbps you'd find that it only takes 30 minutes and costs about $31.40.

5. BULK FILE TRANSFER APPLICATIONS

Nowadays it is not unusual to transfer files that would be considered immense in any frame of reference. Consider the monthly invoices mailed to customers by airlines, large retail merchants, public utilities, oil companies and the like. The raw data are sent to a place where affordable labor is available, each invoice is screen-formatted so that the customer can interpret the charges, and the entire file is sent back to the billing headquarters where it feeds high-speed printers, stuffers and postage machines. At present, some of these files are as large as 30 megabytes!

6. HIGH SPEED FAX

One step up from bulk file transfer is a graphics application that has been slow to mature but shows promise of rapid acceptance in the near future: Group 4 FAX. This is a device that has a user feel somewhat akin to a modern copying machine. Documents are fed into the machine and the images are reconstructed at a remote location.

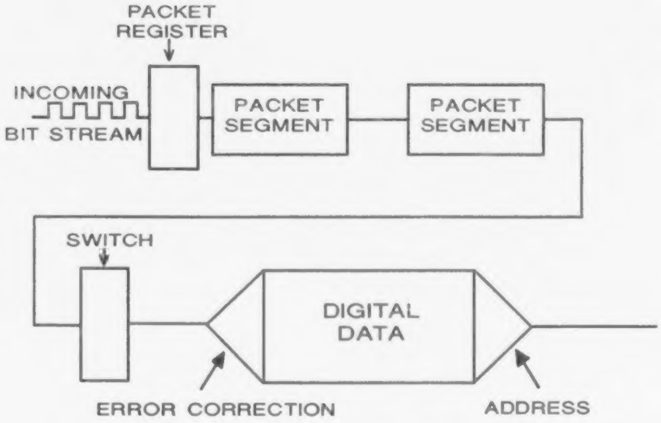
[FIGURE #9]

Group 4 FAX is attractive because the image quality is about the same as one can get from an office copying machine or a laser printer - 300 dots per inch. Most people find the resulting images to be as finely detailed as they are capable of seeing, and if the application demands it, most Group 4 FAX machines offer an option of 400 by 400 dots-per-inch resolution.

Group 4 FAX would be little more than a curiosity if it ran at data speeds common in Group 3 operations where the upper limit is 9600 bps and line conditions often slow things down to 4800 or even 2400 bps. But Group 4 FAX runs at speeds as high as 64 kbps (with automatic drop-back to match the receiving instrument) and can handle a typical document page, with high resolution, in about 3 seconds of transmission time, plus a few additional seconds for handshaking.

Some Group 4 FAX users send camera-ready layouts from the art department to a printer. The printer makes plates directly from the FAX image. My parent corporation is using Group 4 FAX to transmit customs declarations for international airfreight shipments. The declarations arrive before the airplane does, and clearances are ready by the time the packages come off the planes.

Instead of a dozen operators feeding a dozen Group 3 FAX machines and eating up an enormous amount of long distance telephone time, a single operator loads the document feeder of a Group 4 FAX machine and watches the stack zip through the machine in a fraction of the traditional time.


PACKET REGISTER
INCOMING BIT STREAM
PACKET SEGMENT
PACKET SEGMENT
SWITCH
DIGITAL DATA
ERROR CORRECTION
ADDRESS

PACKET FORMAT

FIG. 5

BILLING BY THE BYTE

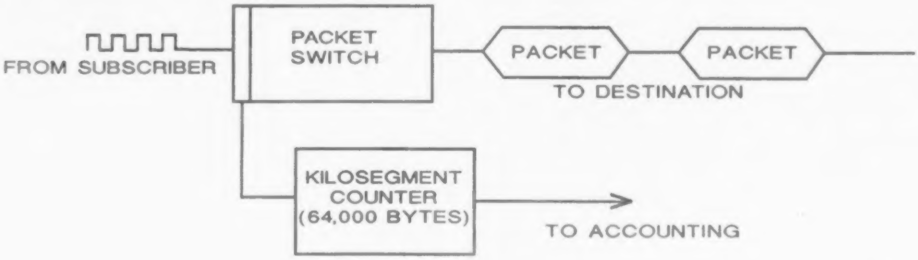

FROM SUBSCRIBER
PACKET SWITCH
PACKET
PACKET
TO DESTINATION
KILOSEGMENT COUNTER (64,000 BYTES)
TO ACCOUNTING

FIG. 6

THE X.25 PYRAMID

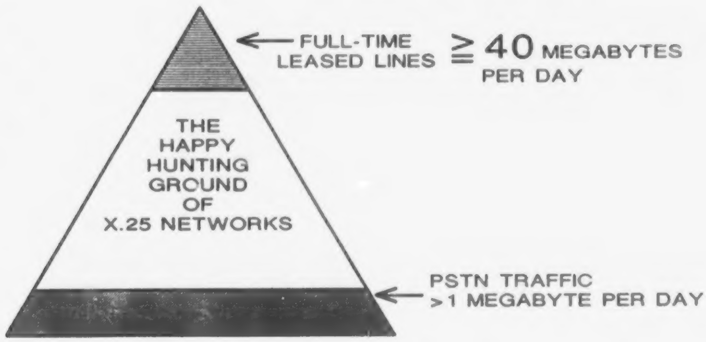

FULL-TIME LEASED LINES ≧ 40 MEGABYTES PER DAY
THE HAPPY HUNTING GROUND OF X.25 NETWORKS
PSTN TRAFFIC >1 MEGABYTE PER DAY

FIG. 7

KILOSEGMENT EQUIVALENTS

TASK	KSEG	PACKET SWITCHED	DIAL-UP
TWO FAX PAGES	1	~20¢	MIN LD CALL
360 K FLOPPY DISK	6	~$1.20	* 10 MINUTES (1200 bps)
10-MEG DATA FILE	100	~$31.40	* 180 MINUTES (9600 bps)

* AT 30¢/MIN, 10 MINS=$3.00; 180 MINS=$54.00

FIG.8

It is also worth noting that packet switched network *connections* are accomplished much faster than is the case over conventional dial-up lines; We demonstrate Group 4 FAX applications in Memphis by sending a graphic image to our Hong Kong office. From the moment we press the key to autodial Hong Kong until the acknowledgement of a good transmission from the other end breaks off the circuit, we use a total of eight seconds.

This is another in a long list of examples where the communications pathway was in place long before the terminal hardware was available.

It is only now that manufacturers have Group 4 FAX machines ready to sell at a price that will earn widespread acceptance. Our network, however, has been available for years.

7. HIGH DEFINITION COLOR PHOTOS

Even at high definition and high transmission speeds, a monochrome printed document is not much of a communications challenge. The challenge is a little more interesting in the case of a high-definition color photograph. Here, too, commercial terminal equipment is about to enter the marketplace in some novel forms.

At least one of the systems we have seen uses a very high definition video camera that records images on a small floppy disk.

An editing console allows a number of operator modifications to the image. The picture might be annotated on an overlay or micro-edited a pixel at a time. Anyone who has used one of the image-editing programs that accompany personal computer scanners is familiar with the concept. When the operator is satisfied with the image, it can be transmitted to another terminal and studied at leisure.

Systems we have seen require a transmission bandwidth of 56 kbps, which is well within the scope of X.25. Our network has been ready for a long time, waiting for users to acquire hardware systems capable of using the available bandwidth.

8. COMPUTER AIDED DESIGN

Bulk file transfers, Group 4 FAX and high-definition color image transmissions are all examples of one-way traffic. X.25 communication capabilities get their toughest test when multicolored images must be used interactively. This is the case when two CAD/CAM work stations at widely separated locations establish contact and the two operators engage in a joint design session.

Screens are constantly updated, redrawn and refreshed. Keyboard control signals fly back and forth. There are colors, weights, intensities and calculations, all of which are defined in terms of kilobytes. If the pathway isn't fast enough to move the kilobytes, the operators will give up on interactive work sessions. Here again, X.25 does the job.

I could cite many additional examples of the growth potential for X.25. As I conclude my summary of the functional capabilities of this well-established and totally reliable network architecture I remind my colleagues that X.25 can comfortably handle a staggering range of traffic; Everything from very low to very high data rates, 300 or less bits per second to 56 kilobits or even 256 kilobits per second. Operationally, we are in good shape for a long time to come.

9. SELLING THE SERVICE

The marketing component of the X.25 equation is equally clear-cut: for an enormous segment of the data communicating public, X.25 is the least costly way to move information across long distances.

Unfortunately, most customers have no experience in dealing with the particular economic framework that characterizes packet switched network tariff structures. Let me explain.

The entry level into data communications, the lowest rung of the ladder, as it were, is the ordinary public switched telephone network. Anyone with a modem can dial up a suitably-equipped distant terminal as if it were a regular voice telephone call, establish digital contact and do whatever must be done.

The user understands the communications cost structure because it is the same one that governs the cost of placing a telephone call to Aunt Alice in Antwerp.

There are many ways to control the cost of long distance phone calls. The user can confine calls to off-peak hours, or sign up with one of the specialized long distance service companies, or purchase block time in some special offering, etc. Regardless of the particular selection made by the user, cost is always related to the product of time and distance. I might remind my audience that this is also true for "Switched 56" service.

At the very top end of the data communications pyramid, a rather different economic paradigm is in force. Here the user makes an outright purchase of a wideband signal path and pays a fixed fee to have that path available all the time. Portions of the leased bandwidth can be allocated for the use of different departments, if that's how a given user elects to do things, but the economic analysis generally requires a year of experience before cost comparisons can be made. Very large organizations have no difficulty with this approach: their costs would be much higher without their full-time wideband circuits.

Between the dial-up user of the Public Switched Telephone Network and the full-time user of a leased circuit, my company and others like mine provide international data communications based on traffic volume and time.

There are additional minor components in the tariff structure of our networks, of course. We charge a fixed monthly fee for each customer port and the fee depends on the circuit speed.

[FIGURE #12]

Well, it seems simple enough to us. The customer tells us how many kilosegments of traffic he moves each month, and we tell the customer how much we would charge to move that much data.

I see some smiles. The fact is that very few customers have any idea of their data communications traffic volume. They may be able, through careful cost analysis of their telephone charges, to arrive at a rough estimate of the time their data processing department is on the phone, but when it comes to questions about kilosegment count, they are lost.

The marketing process, therefore, consists of three-steps. First we have to establish acceptance of the fact that packet-switched data communications networks can, indeed, save important sums of money for organizations of a certain size, with business locations in certain places.

The second chore is to identify what the prospect is currently spending on long distance tariffs for data communications.

The third part of the process is to translate the prospect's data communications traffic into kilosegments, and to present a fair and accurate cost comparison.

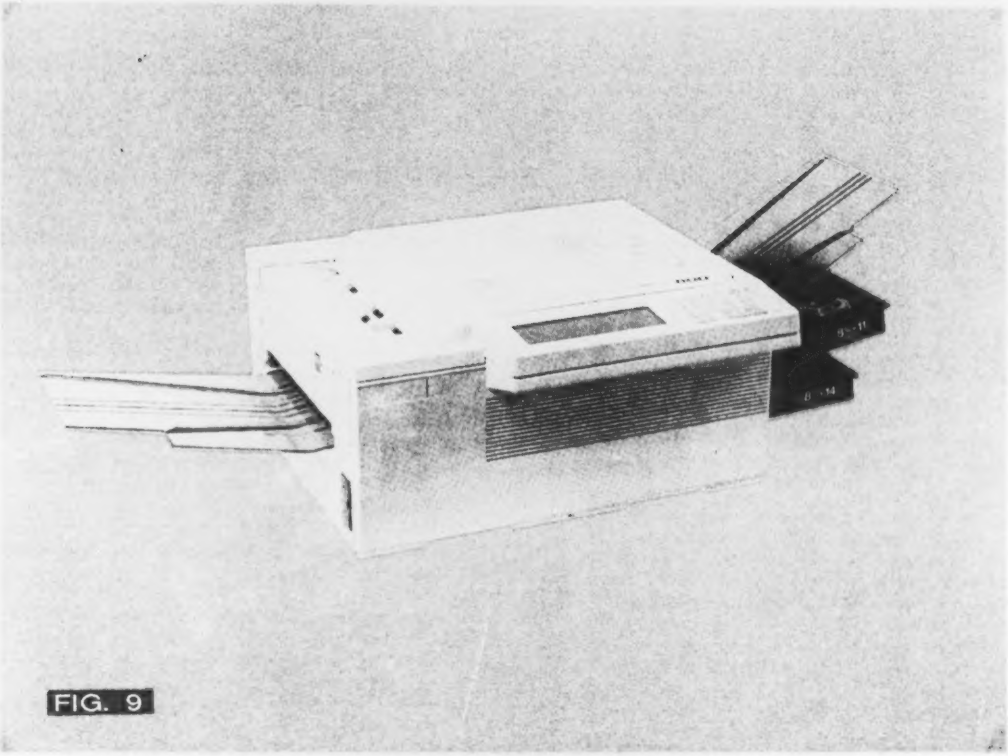


FIG. 9

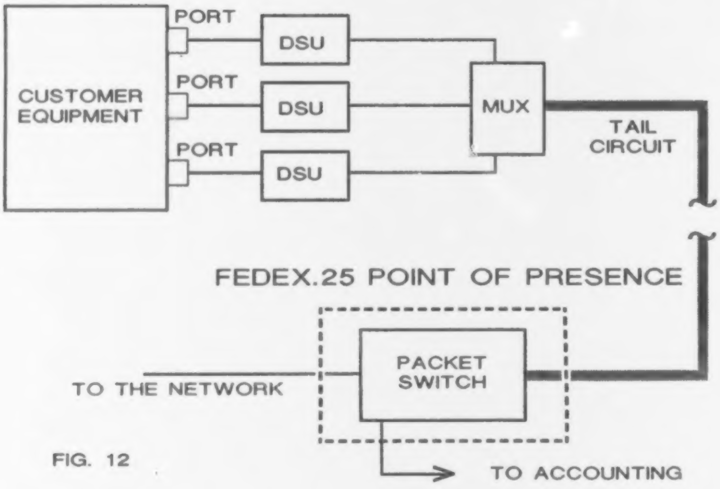

CUSTOMER EQUIPMENT
PORT
PORT
PORT
DSU
DSU
DSU
MUX
TAIL CIRCUIT
FEDEX.25 POINT OF PRESENCE
PACKET SWITCH
TO THE NETWORK
TO ACCOUNTING

FIG. 12

BEST COPY AVAILABLE

The first two elements are fairly straightforward. Ordinary marketing communications techniques establish the issue and ordinary accounting practices can reveal current costs.

The kilosegment arithmetic is eased by the use of certain standard conversion factors, along the line of examples I cited a few minutes ago.

Once the numbers are available and the prospect sees how much money could be saved by switching data communications over from PSTN to a packet-switched network, the sale should be an easy one to make. In our favor.

10. TENDING TO THE NETWORK

Meanwhile, those of us on the engineering side of the business tend to our network. We make sure that all of the T-1 circuits we operate in the United States, the full-capacity cable circuits we maintain to Asia, the cable circuits we have to Europe and the satellite channels we currently employ are in good shape. Nodal control points are protected by parallel switches ready to handle the traffic and change trunk routes on the fly, without dropping so much as a single bit.

Our diagnostic scanning capability extends to every circuit board in every rack in every point of presence.

My company operates one of the world's most modern telecommunications systems, and we do it in a very competitive environment.

It seems odd to some industry observers that a telecommunications "outsider" such as Federal Express is in the digital common carrier business. Perhaps a concluding comment or two will clarify the issue:

First, our parent corporation, Federal Express, is an enormous consumer of telecommunications services at all levels. Our customers telephone us all day long to arrange pickups, and these phone calls amount to some 250,000 on an average day. Think of a single business operation trying to field 250,000 telephone calls a day, five days a week!

The customer calls, of course, generate additional communications. Pickup instructions are relayed directly to the trucks over a digital radio link. There are some 200,000 digital messages sent to trucks each day.

And then there is airfreight traffic control. The Federal Express fleet now numbers over 300 airplanes, each of which must be tracked on a constant basis.

If you've ever called Federal Express about the status of a shipment, you know that we can track packages and receive information on a real-time basis as a direct result of our telecommunications ability.

Given all of these needs, and the requisite infrastructure that it takes to install and maintain the traffic, an expansion into common-carrier activities seems almost inevitable.

Then, too, it can be argued that the transportation of information by digital signaling is little more than a special case of the Federal Express business mission. Some of the "packets" we move from point to point are physical and some are electronic. Some require trucks and airplanes and some call for packet switches and broadband carrier circuits. But it all amounts to transportation.

[FIGURE #13]

11. WELL-ESTABLISHED AND THOROUGHLY PROVED

Through it all, we and our customers are well-served by X.25. It'll be a long time before user requirements catch up with the capability of this well-established and thoroughly-proved way of getting digital information from place to place.

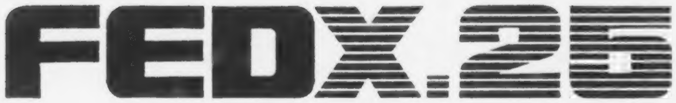


FIG. 13

A Frame Relay Overview

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O. ABSTRACT

Many changes in the data communication environment have resulted in the need for an efficient, high-speed, wide area networking technology. One such technology is frame relay. This paper describes frame relay's origins and the technology itself. Frame relay is then compared with other communications options.

I. EXECUTIVE SUMMARY

Today's data communications environment is characterized by widely distributed processing power, interconnection of multiple local area networks (LANs), and by a flurry of new data applications such as financial and medical imaging and PC-to-PC file transfers. In such an environment, the communications network must be of high speed in order to satisfy the response time requirements of PC and local area network (LAN)-oriented users. And, given the propensity of traditional as well as new applications to send large quantities of data across a network in bursts, the network must also be able to *economically* provide high-capacity bandwidth when and where it is needed.

This environment has produced a new technology, known as frame relay, which effectively addresses these requirements. Frame relay possesses some characteristics of both packet switching and circuit switching. Like X.25, frame relay networks use bandwidth only when there is traffic to send. However, like circuit switching, frame relay is transparent to most data communication protocols in use today and can switch traffic at relatively high speeds.

Frame relay works in conjunction with intelligent user endpoint devices, such as a LAN router, a front-end processor, or an X.25 packet switch. In essence, frame relay is a signalling and data transfer mechanism between these endpoints and the network for the purpose of effecting instantaneous bandwidth allocation, as well as for routing data to the desired destination. The initiating endpoint places a destination identification number in each data frame before the frame is sent to the frame relay switching node. The switching node interprets this number as a real network address, and sends the frame on its way to that destination. This process simplifies, and thus speeds up, the processing performed by the switch. It also enables each endpoint to communicate with multiple destinations via a single access link to the network.

Further efficiencies are gained by delegating some value-added functions, like error correction, to the endpoints. Frame relay technology relies on the presence of these intelligent endpoint devices, as well as on the availability of highly reliable transmission lines to minimize transmission errors. Fortunately, both are in wide use in today's communications environment.

Within this environment, T1 time division multiplexers are widely used to build corporate networks. Yet these devices have no means of recognizing signalling from endpoints. Thus, multiple lines must be deployed between the endpoint and the multiplexer if the endpoints are to have direct access to each other. Frame relay, in contrast, requires only a single such link, and therefore reduces both port and line costs. Furthermore, consolidation of traffic over a single access link allows the cost-effective deployment of higher speed lines, which results in a response time improvement for data traffic.

In summary, frame relay technology offers speed, efficiency, flexibility, and economy when compared to alternative solutions. Frame relay switches, as well as frame relay-compatible LAN and X.25 products, will be available in the first half of 1991, making this technology of immediate interest to communications planners. Public frame relay network services and frame relay-compatible front end processors are expected to be available later in the same year.

II. INTRODUCTION

The pace of technology development in the telecommunications industry is proceeding at an impressive rate. Only a few short years ago, local area networks and private T1 networks were a rarity, facsimile machines were usually considered a headache, and video conferencing over dial circuits was unthinkable. Clearly, in the past decade alone, we have seen many significant advances.

And yet, some of the benefits users anticipated from these technologies have remained elusive. Paramount among these is the ability to support all traffic types--voice, data, video, and facsimile--in an economical, manageable, and flexible manner. One means to this end is through a network which yields economies through consolidation of multiple networks and services. Ideally, such a network would serve as a "corporate utility" supporting voice, data, video, and facsimile traffic over an efficient, integrated backbone.

Today's solution alternatives, such as T1 multiplexers and ISDN services, offer traffic integration only in a rudimentary fashion, and lead to inefficiencies and costs. Expensive long-haul backbone transmission facilities are regularly underutilized, while the lack of a high-speed switching capability results in a loss of flexibility and further costs.

The solution to true integration and high-speed switching exists in the form of an evolving technology known as Fast Packet Switching (FPS), Asynchronous Transfer Mode (ATM), or Broadband ISDN (B-ISDN). Unfortunately, fast packet technology will not be generally available for several years, and public Broadband ISDN services, based on that technology, are even farther off.

However, there is another technology which can deliver today many of the advantages of FPS and B-ISDN. Frame relay is a technology that can be used to build public or private networks which provide efficient traffic integration, as well as high-speed data switching capabilities (although not as high speed as FPS will eventually offer).

This paper will consider the environmental trends in the communications and computer fields which led to the development of this powerful new technology, and will then describe the technology. We will also compare frame relay technology with other communications options that are available today. The conclusion will summarize the status of frame relay as a product and as a standard.

III. COMMUNICATIONS ENVIRONMENT TRENDS

In the past few years there have been significant changes in the environment in which a communications network must operate. These changes fall into three areas: user applications, user equipment, and transmission facilities.

USER APPLICATIONS

Several new classes of user applications have arisen with characteristics which directly impact the network. Video conferencing, for example, requires only modest quantities of network capacity (bandwidth) *on average* for acceptable picture quality. However, when there is rapid movement, or when a change of background occurs, a large peak of bandwidth is momentarily required to preserve a satisfactory picture. Applications with this characteristic are called "bursty" in nature and such applications are proliferating. A very high capacity (and expensive) network is called for to adequately support such applications, unless a means can be found to allocate bandwidth "on demand."

Another new and bursty application is related to but broader in scope than video conferencing. This is the area of graphics and imaging. Image processing, used by financial and medical institutions to send digitized images of checks or x-rays, is becoming increasingly popular. Like video conferencing, image processing can at times use a tremendous amount of bandwidth. Yet, since the bandwidth is only required sporadically--when a check is to be transmitted, for example--image processing is considered bursty in nature.

Finally, there has been a widespread deployment of personal computers (PCs) which frequently exchange files or download programs from file servers. PC programs tend to be fairly lengthy and therefore, again, require quite a bit of bandwidth. But PC-to-PC and PC-to-server communications tend to require bandwidth only on an occasional basis, and are therefore also considered to be bursty. The operation of sending a PC program or file from one place to another is not performed very often.

Several of the more traditional computer applications are also bursty in nature, and they continue to be popular. For instance, interactive transactions or database inquiries always have been bursty, the primary distinction being that new applications have longer bursts. These facts have significant ramifications on the type of network that is called for to efficiently deliver the high amounts of bandwidth required to support these applications.

Another characteristic of many new applications is that high amounts of bandwidth are not used simply for capacity but also for speed, which translates to response time. It takes only one-quarter of a second to transmit a two-page memo through a network at 64 kilobits per second (DS-0). A one-quarter second of delay seems perfectly acceptable in this case, which we might consider a traditional application. That transmission time improves to a 100th of a second by using DS-1, or T1 (1.55 million bits per second) rates, but the improvement would scarcely be noticeable to the user.

However, taking an example of a newer application, a one-page graph sent across a line at 64 kbits/s takes 12 seconds. At T1 rates, the delay is reduced to only one-half of one second. This is a significant difference, particularly to a LAN-based user accustomed to sub-second response times.

Sending even lengthier transmissions--such as a typical PC program--across a line at DS-0 rates, would result in a delay of a full minute, a completely unacceptable level of performance. At T1, on the other hand, the delay is reduced to a far more palatable 2-1/2 seconds. These examples illustrate that at higher speeds, such as T1, there is a very significant reduction in transmission times which will yield a corresponding improvement in response times, particularly for newer applications. The high capacity requirements of these new applications, combined with the desire for acceptable response times, naturally results in a trend toward the use of high speed lines.

USER EQUIPMENT

Another major change that has taken place in the communications environment is in the type of equipment being used. There has been a progression from the use of fairly "dumb" terminals communicating with a centralized computer, to a distribution of computing power. The computing power of a PC or workstation is now on the desk of many users. Access to other computers is needed, at times, for file transfers or database transactions. Where there is such a distribution of communicating computers, the network can actually be thought of as part of the computer itself; the network effectively acts as an "extended bus" connecting the different processors together and enabling them to act as one larger computer.

Also there is a trend toward increasing use of data concentration devices (DCDs) over the next few years. Direct connections of terminals to networks are declining in favor of connection through DCDs. Examples of DCDs to which a user terminal or host might connect include local area networks (LANs), X.25 packet switches, front end processors and ISDN terminal adapters. All of these devices are intelligent and typically communicate across a wide area network (WAN) using a built-in, high-level protocol.

For example, LANs talk to each other over a WAN using protocols such as TCP/IP, XNS, or IPX. Packet switching devices communicate over a WAN using X.25 and X.75. Front end processors typically use SNA. All of the protocols employed by DCDs provide a robust, end-to-end error detection and correction mechanism. These trends in user equipment have significant ramifications on the type of communications network that is called for.

TRANSMISSION FACILITIES

Finally, there has been an evolution in the transmission facilities which are available to build WANs. In the United States, analog copper, microwave, and satellite circuits are being steadily replaced by digital circuits, primarily optical fiber-based. This trend is also apparent in Japan, Australia, Europe, and in transoceanic facilities. It must be noted, however, that the remainder of the world is well behind the geographic areas noted. Within the geographic domain offering fiber service, however, users experience much lower bit error rates, and thus circuits with much higher accuracy and availability.

NETWORK RAMIFICATIONS

Bringing all of these trends together, we can arrive at some conclusions as to what is needed from a communications network. First, to support the rapid transfer rates that are preferred for many new applications, and to deliver the response times that are demanded by LAN-based users, a high speed wide area network--T1 or above--is called for. (In Europe and in most countries outside North America, there are no "T1" lines as such. The closest equivalent is the CEPT (Conference of European Postal and Telecommunications administration) standard for primary rate lines, which operate at approximately 2.0 million bits per second. In the remainder of this paper, we will refer to these as "E1" lines).

Second, because both traditional and newer applications are bursty in nature, a network which can allocate bandwidth on demand is optimal for bandwidth efficiency. Traditional technologies, like circuit switching and time division multiplexing (TDM), dedicate a fixed amount of bandwidth to applications and/or to user devices. In the current environment, that bandwidth would be idle much of the time. As traffic becomes more and more bursty, these approaches become less and less cost-effective.

A packet-mode network of some sort is required in order to provide the high bandwidth needed by the bursty traffic, but only when it is needed. All packet technologies have in common that the bandwidth is utilized only when required; but when it is required, full bandwidth is delivered. When bandwidth is not being used by one particular application, the same bandwidth is then free to be used by another application. It is this bandwidth sharing, as opposed to the dedication of bandwidth to specific applications in circuit-mode technologies, that enables packet-based networks to be more efficient for bursty traffic.

Finally, because the transmission facilities themselves are introducing fewer errors, and because the endpoints and data concentration devices are intelligent enough to provide high-level functions such as error recovery, the same functions do not need to be performed within the network. Thus the network itself can be streamlined in its functionality.

In summary, a network suited to today's communications environment must provide a high-speed service to accommodate the large traffic bursts and response time requirements of modern uses. It must do this in a manner which is sufficiently economical to enable high-bandwidth applications to become viable. Frame relay, a high speed, packet-mode, streamlined technology, meets these requirements.

IV. TECHNOLOGY DESCRIPTION

The reader should now have an understanding of the trends which led to the development of frame relay. We will now turn our attention to a description of how frame relay technology actually works; the characteristics of a frame relay network; how frame relay relates to ISDN; its benefits and limitations; and a few typical scenarios in which frame relay can be deployed.

FRAME RELAY AS A SWITCHING TECHNIQUE

One of the easiest ways to describe frame relay, which is a signalling and data transfer mechanism between intelligent endpoints and an intelligent communication network, is in comparison to a technology, like X.25, that is well-known and understood. Both technologies are packet-mode and provide for data switching. What is meant by switching here is the ability to examine incoming data in order to determine its destination and to route the data accordingly. In packet-mode technologies, this is usually done on a packet-by-packet (or frame-by-frame) basis. In circuit-mode technologies, it is done on a call-by-call basis.

X.25 networks use three levels of the International Standards Organization seven-layer network model to achieve switching. The first layer is simply a physical layer which provides physical and electrical connectivity of a user device to the network, or between two network nodes. The second layer is the data link layer, which is responsible for ensuring data integrity across a physical link. The third layer, the network layer (sometimes called the packet layer in the X.25 world), is tasked with end-to-end data integrity and with ensuring that the data reaches the correct destination.

In X.25, data is taken from the source device, such as a terminal, and is stored for processing and to make retransmission possible. A "packet envelope" is then placed around the data. The envelope contains information about the data inside it. This information is used at the other end of the network to determine if the data arrived without errors, and to request retransmission in the event that errors are detected. There is also information in the envelope which is used to guide the data through the network to the proper destination.

Based on the packet envelope information, the network makes a determination as to where the data should now be sent. At this point, a "frame envelope" is placed around the packet envelope. This new envelope is responsible for ensuring data integrity across a single physical line. The data is then sent, via the physical layer, over the appropriate copper or fiber (or satellite, etc.) facility to the next mode in the network.

When the data arrives at the next node, it is once again stored, and is then examined for errors. If an error is found, the faulty data can be retransmitted from the previous node, where it was stored before transmission. If no error is found, the network will strip off the frame envelope and look at the packet within the frame to determine the ultimate destination of this piece of data. If necessary it will then route it to yet another node. This process will continue until the ultimate destination node is reached, where are all envelopes are examined, then removed, and the data is delivered to the endpoint user device.

It is clear from the complicated manner in which X.25 accomplishes switching that it evolved in an environment where the endpoints were not particularly intelligent and where high quality transmission lines were not available. That is why X.25 goes to great lengths to ensure that transmission errors are corrected on a link-by-link basis.

In contrast to X.25, frame relay accomplishes switching in only two layers as opposed to X.25's three layers. In frame relay technology, an intelligent endpoint, such as a LAN, will send its data to the link layer where, just as in X.25, an envelope (specifically, a LAPD frame) is added. Alternatively, the intelligent endpoint may send the data to the network already encapsulated in the LAPD frame. In either case, this frame contains routing information not previously found in layer two, eliminating the need for the network to examine level three, the packet level. Instead, the frame itself is examined for a destination and the routing takes place at the network's frame layer.

Compared to X.25, frame relay performs some additional functions in layer two of the network model; notably the switching we have discussed. Yet, there is also a conspicuous absence of certain functions. For instance, there is no error correction in the frame relay nodes. This is because frame relay relies on low bit-error-rate lines to minimize errors, and on intelligent endpoints running an end-to-end protocol across the network to recover from the few errors that do occur. The frame relay network can detect errors, but the endpoints must correct them.

Further, while X.25 networks invariably store data at one node before sending it to another, a frame relay network may dispense with this step. Thus, when each node receives the beginning of a frame, it may immediately begin transmitting that frame to the net node without having to wait first for the entire frame to be received and stored. Here, then, is one reason why frame relay is a faster transmission and switching mechanism than is X.25. However, some X.25 networks have the ability to segment data into "subframes", and to process and transmit the first sub-frames before the full frame is received. This increases an X.25 network's throughput, but not to a level comparable to frame relay.

Frame relay gains the bulk of its speed advantage because there is no processing taking place at layer three. Some layer three processes, such as flow control, are left to the intelligent endpoints. Others, like PAD control, are not relevant to the intelligent endpoint environment. Since there is less complexity to the processing required of each node, there is less delay through the node itself: about 5-20 milliseconds for X.25 versus less than two milliseconds for frame relay. This reduction in delay at each node directly improves network response time.

The next question is, "How does frame relay accomplish this switching in layer two when prior to now it has only been possible by having three layers?" The answer is described below.

First, an intelligent endpoint such as an X.25 packet switch, a LAN with a router, or a front end processor specifies the destination of each frame. Intelligent endpoint devices such as these know the destination of each frame from the application, and place such information in the packet layer of the protocol. With frame relay, however, an abbreviated destination is also placed in the frame layer.

For example, a LAN may need to send data to one of ten other LANs in a network. It is not necessary to specify at the frame layer the exact terminal or workstation for which the data is destined. That information is in the packet being carried within the frame envelope. All that is necessary for frame relay is that the first LAN specify that this data is destined for, say, LAN #7. This destination endpoint is specified in the actual frame via a "connection identifier." In the example given above, there might simply be a connection identifier that says "7." In more formal terms the connection identifier is known as a Data Link Connection Identifier (DLCI).

In order for this process to take place, the frame must conform to the LAPD standard of the ISO networking model, the frame format for which is given by CCITT Q.922. Q.922 is a subset of the full LAPD protocol (Q.921), but does not require the user to implement the error recovery procedures of Q.921. LAPD was chosen for frame relay because virtually every data protocol likely to be sent across a WAN conforms to, or can easily be made to conform to, the LAPD frame format. SNA, X.25, TCP/IP and virtually all proprietary vendor protocols, such as DECNET, can be used with LAPD. This makes frame relay compatible with a tremendous variety of higher level protocols.

After the intelligent endpoint has determined the destination address and placed this in the DLCI within the frame, it sends the frame out the transmission facility to the first switching node, which we will call a frame relay switch. The frame relay switch then reads the DLCI and routes the frame accordingly to the next node along the way to the destination. Note that the routing takes place without the frame relay switch ever having to look at any higher level protocol; all of the routing decisions are made at layer two of the network.

The frame continues to be routed in this way through the network until it ultimately reaches the destination node. Only at the destination node, in this case at LAN #7, are the higher layers of the protocol examined to determine the actual user who is to receive this particular frame of information. The destination endpoint node then delivers the frame to that ultimate user. Level three and above are still needed, but are now used primarily at the endpoints. There is no need for the network in the middle to look at this information, so long as it can accomplish its switching functionality at a lower layer of the architecture.

NETWORK CHARACTERISTICS

A frame relay network is protocol transparent above layer two. It can carry any protocol so long as that protocol is using LAPD at layer two. Existing protocols which use other than LAPD at layer 2 can be enveloped in a LAPD frame, which gives frame relay tremendous flexibility in terms of the types of devices connected to the network. Most existing IBM, DEC, and LAN networks can ride over a frame relay network and the endpoints will not even realize that frame relay is there. To them, the frame relay network appears as an array of full period, high-speed circuits, which is exactly what they would like.

Another characteristic is that traffic to and from multiple destinations can be supported via a single, high-speed link between the intelligent endpoint and the network. This is similar to X.25 except that the frame relay link can be a higher speed.

A frame relay network provides what is known in the X.25 world as a permanent virtual circuit (PVC) type of service, meaning that whenever an endpoint needs to send data, there is a pre-established path through the network for that data to reach its destination. Note that the path does not reserve any bandwidth, but it is pre-established and ready to go. The frame relay switch merely waits for a connection identifier to signal which path is to be used for a particular frame.

Frame relay service in its first implementations also resembles another X.25 concept, that of the closed user group (CUG). In the frame relay technology that we have described, it is *not* the case that any endpoint can arbitrarily talk to any other endpoint on the network. Rather, there must be a connection identifier associated with the destination endpoint the sender is trying to reach or the data will have no way to get there. Thus, in effect, there are one or more "user groups." Within each group, devices may communicate at will. These groups are established by the network manager using configuration tools. Of course, the configuration can be modified at any time, but essentially the network will consist of several closed user groups. In practice, this is not particularly limiting since most endpoints do talk only to a fixed set of destinations.

However, there is a future enhancement to frame relay under consideration in the standards organizations which would involve the use of Q.931, the layer three signalling protocol for ISDN networks. Q.931, if appropriately amended by the CCITT, would allow an endpoint to dynamically specify a destination address for a frame, even if that destination address had never been specified before and was never pre-established with its own connection identifier. This will enable frame relay networks to have unrestricted connectivity, without the prior establishment of permanent virtual circuits.

RELATIONSHIP TO ISDN

When ISDN was originally conceived about a decade ago, it was anticipated that it would be the transport mechanism for several different types of traffic. This would be accomplished by providing specialized transport facilities known as bearer services. One type, circuit-mode services, would be used for voice and transparent data. Another service anticipated was packet-mode, intended to support X.25 traffic. Subsequently, a third type of service, frame relay mode, was incorporated into ISDN planning. It was thought that there would be some types of data that would not be X.25, but would not be efficient for a circuit-mode service. Frame relay would fit the bill as a service in between circuit-mode and packet-mode, being packet-oriented like X.25, yet protocol transparent above layer two (but still not fully transparent) like circuit mode.

The essential point is that frame relay traffic can travel easily over an ISDN network. However, it is important to note that one does not *need* an ISDN network to take advantage of the benefits of frame relay. Frame relay is perfectly well suited to any private line network and to non-ISDN public data networks.

BENEFITS AND LIMITATIONS

Among the benefits gained by using frame relay is the very low delay through a frame relay switching node. The overall delay of the network itself is also reduced because high speed access lines are used and because the full bandwidth of the backbone lines is available to the data as it traverses the network. Together these two benefits combine to reduce the time users must wait for the network to complete a transaction; thus, productivity is increased.

Further benefits are derived because a single access line between an endpoint and the frame relay network can support traffic going to many destinations. Ports are saved on the endpoint device as well as on the switch itself. Another benefit of frame relay is its protocol transparency above layer 2. Frame relay allows switching of X.25, SNA, TCP/IP, or any other HDLC-like protocols, with equal ease.

Finally, because frame relay performs data switching, the network achieves mesh connectivity of endpoints; that is, any endpoint can communicate with any other endpoint so long as there is a pre-established connection identifier. Even better, this full connectivity is achieved without any penalty whatsoever in terms of number of ports, number of access lines or capacity required on the backbone trunks. Frame relay can also coexist with ISDN, but does not require ISDN. It will be compatible with future implementations of ISDN, such as B-ISDN. In summary, frame relay effectively meets the modern requirement for a high-speed, packet-mode network.

Still, there are several limitations to frame relay technology which must also be considered. As has been consistently pointed out, frame relay will not work well unless it is used in an environment where the endpoints are intelligent and the transmission facilities are of high speed and quality. Also, frame relay does not support voice. The reason is that voice traffic is highly sensitive to variations in the transmission delay introduced by the networks, while such small variations are usually not as critical to data traffic. In order for voice to be supported satisfactorily in a packet-mode environment, each packet must have a time-stamp which is monitored by the network. Frame relay lacks such a mechanism.

An additional limitation is that access links to a frame relay network are currently limited to T1 or E1 rates, though it is important to note that there is no such limitation on trunk speeds. This is not a formal restriction which can be found in standards;

rather, it is a limitation of current technology and its ability to process at the link layer. Future implementations of frame relay will undoubtedly support access speeds up to T3 (45 million bits per second) rates.

Another limitation is that there is presently no standard congestion control process defined for frame relay. This means that if all the LANs connected to a frame relay node had bursts of data to send at the exact same instant in time, and if these bursts were long enough to exhaust the node's buffering queues, the network would overflow and some of those frames would be dropped. However, these congestion situations are rare if the network is engineered properly, and when they do occur the intelligent endpoints' end-to-end protocol will realize that data did not get through. The endpoints will then recover by retransmitting the missing frames.

Nonetheless, it would be advantageous for the frame relay network to be able to flow control endpoint devices that were sending data when there was no capacity available in the network. Such a mechanism would avoid the possibility of clogging the network with retransmitted frames. A feature has actually been built into frame relay to enable the network to inform endpoints of network congestion. Unfortunately, there is not yet a standard delineating how an endpoint should respond to this information. It is expected that within a year there will be an agreement on this issue.

Lastly, due to its streamlined nature, frame relay is limited in the value-added functions it supports compared to X.25. Some of these functions may be important to certain applications. Examples include security and protocol conversion. If a user requires these value-added capabilities in a frame relay environment, one approach would be to use an X.25 device as the intelligent endpoint. This endpoint can in turn be connected to user terminal and host devices. In such a configuration, one achieves the additional value-added capabilities of X.25, with the efficiency of a frame relay transit switching fabric.

DEPLOYMENT SCENARIOS

Now let us look at some deployment scenarios which involve frame relay. The first scenario is a typical corporate backbone network without frame relay. At the core of such a network might be three T1 multiplexers which are being used to interconnect a variety of LAN routers and packet switches or front end processors over a shared T1 backbone. Because T1 multiplexers are indeed strictly multiplexers, and not switches, note that multiple links between each endpoint and the multiplexer itself are needed to create a mesh connectivity. If there were only one link between a LAN router and its associated T1 mux, for example, the mux would have no way to determine where each incoming frame was destined since a mux does not examine data but merely passes it to a fixed destination. A LAN router, for instance, requires three links to the associated T1 mux to serve traffic that goes to each of the other three possible destination LAN routers. As a network grows, this phenomenon becomes increasingly burdensome in terms of port requirements on both the endpoint and the T1 mux.

Also, since most T1 multiplexers are circuit-mode in nature, the bandwidth on the backbone trunks will be pre-allocated for each of these connections, despite the fact that the traffic will bursty in nature and the bandwidth will be idle much of the time. This results in the need for more trunks in order to provide the speed that is required by modern applications, or fewer trunks with associated compromises in the speeds that can be delivered to the end user. Most users, constrained by budgets, elect the latter option and allocate some small portion of the T1 backbone to each application. Thus, although physically there are T1 trunk lines, the *effective* transmission speed between endpoint devices will be only that portion of the trunk which has been allocated to the application; typically, on the order of one DS0. That means the customer's investment in a T1 network, while yielding some economies through consolidation, will *not* deliver the highspeed transmission rates called for by modern applications and PC users.

Now let us consider the same network with frame relay. The T1 muxes in the middle will be replaced with frame relay switches; for example, a Sprint TP7900 or TP4900 frame relay switch. The multiple access links between endpoints and the T1 backbone will be replaced by a single, frame-multiplexed link. Because the frame relay switch indeed will examine and route each frame to whatever destination is specified, this network still offers full mesh connectivity. Every device can talk to every like device, just as in the previous network. However, a considerable amount has been saved in terms of ports on the endpoint devices, and ports on the T1 resource manager. Further, transit delay is reduced because each application receives the entire T1 backbone bandwidth on demand, rather than being allocated some subset of that bandwidth as in the circuit-mode environment.

Although, as previously explained, frame relay does not support voice directly, it is nonetheless possible to build a corporate backbone network that supports both frame relay data traffic and voice traffic. PBX's can be connected to a TP7900 using standard channelized (non-frame relay), primary rate interfaces. As with all current T1 multiplexer solutions, voice traffic cannot be switched, so the TP7900 is used simply to establish connectivity to pre-specified destinations. However, the salient point is that the same backbone can carry voice, video, fax and all other nonframe relay traffic as well as frame relay traffic. All of this traffic will be packetized and efficiently integrated on a common backbone, yielding all of the economies of a packet-mode service along with the switching of frame relay for compatible devices.

V. TECHNOLOGY COMPARISON

Now let us turn to a comparison of frame relay with other technologies that are available to today's communications managers. One way to accomplish this is to take a look at a number of network characteristics, then compare available technologies against that set of characteristics.

NETWORK SWITCHING

The first network characteristic we will discuss is switching. Given the distributed nature of today's data networks, it is often advantageous for the network to enable any-to-any connectivity of user devices. But how does one actually accomplish such connectivity over a Wide Area Network? One possible approach is simply to physically connect every pair of devices with point-to-point leased lines. In such a case there is no network-based switching. Instead, a LAN router, FEP or packet switch is relied upon to switch the traffic to the proper line. For a three-node network, this would require only three lines. In a four-node network, however, mesh connectivity would require six lines--double the number of lines in order to support a single additional node.

As can be seen, with this multiple point-to-point leased line approach, the number of lines required for full connectivity does not rise linearly with the number of nodes. In fact, the line requirement rises in proportion to the *square* of the number of nodes, as given by the following formula: to fully interconnect N nodes requires N x (N-1)/2 lines. For example, a six-node network would need 6 x (5)/2 = 15 lines. Clearly, this is an extremely approach to full connectivity for networks of any size.

An alternative to full connectivity is partial connectivity. Six LANs or front end processors (FEPs) can, in fact, be interconnected using only six lines in a "ring" configuration. As we have pointed out, the LAN router or FEP does, after all, have the ability to switch traffic, so this configuration will deliver the sought-after any-to-any connectivity, and at a substantially lower cost than the prior approach. Indeed, this particular topology is in widespread use today.

The drawback to partial connectivity is that since there is often no direct path between two endpoints, there is the necessity of a large amount of "transit" traffic. Transit traffic is data which passes through a node--called a transit node--but neither originates nor terminates on that node. Transit traffic robs a transit node of processor cycles which would otherwise be used to support traffic which originated or terminated at that node. Because any intelligent node has a finite number of such cycles, transit traffic inevitably leads to the need for larger or additional nodes--at additional cost. Moreover, since every "hop" along the path from source to destination adds delay, a partially interconnected network has inherently more delay than a full mesh topology network. Thus, although one reduces line requirements through partial connection, there are indirect costs in terms of transit node hardware and delay.

A third alternative to which users have turned is the deployment of a T1 backbone and associated bandwidth managers (muxes). This scheme enables a logical, though not a physical, full mesh topology over a consolidated, high-speed backbone. Unfortunately, this approach also contains all of the drawbacks previously noted. For N nodes to interconnect, there must be N-1 links between each endpoint and the nearest T1 mux. If the endpoint and T1 mux are not co-located, this will constitute a major expense in access lines. And even if they are co-located, there will be high physical port costs on both the endpoints and the mux.

Fortunately, there is a fourth alternative. This alternative shall be referred to as "network switching." If the *network itself*, in addition to the intelligent endpoints, can switch traffic, then any-to-any connectivity is easily and economically achieved. Under this scenario, an endpoint requires only a single link into the network. That link can carry all of the traffic from one endpoint into the network. The network then actively examines and routes traffic to the proper destination. Since only a single link is needed, only one port per endpoint is required, though a second may be desired for redundancy. Because the network itself provides any-to-any connectivity and handles all required transit traffic, no customer endpoint need handle any transit traffic. In summary, a switching network facilitates full connectivity without the detrimental side-effects of alternative approaches.

There are several technologies available which offer network switching, including the good old public dial telephone network (your telephone has only one connection to the network, but can connect with any other phone). These technologies will be compared to each other, and to other technologies, below. However, there are several characteristics besides network switching which must also be compared.

ADDITIONAL NETWORK CHARACTERISTICS

Ideally, a network will have very rapid call setup, especially given that entire transactions can now last only a matter of seconds, or milliseconds at T1 rates. It would not be very appropriate for a network to take 10-20 seconds to establish a call that is only going to last a half-second!

Also desirable is the flexibility to handle a wide variety of protocols, particularly given the recent proliferation of "standard" protocols. Some network offerings enable network management by the actual user or customer, while others do not. Likewise, some networking technologies increase overall network availability through the ability to route traffic around failures in the network. The latter characteristic is known an alternate routing.

Finally, because of the trends discussed earlier, we will discuss the ability of each networking option to be economical for high-speed, bursty traffic, since that is the nature of most of the traffic the network will carry.

DIAL SERVICE

Dial service is a switched service whereby the user specifies where traffic is to go by dialing a specific telephone number. Yet while dial service is switched in nature, it differs from other switched services (which we will discuss) in that it is not statistically multiplexed. That is, one dials a number to specify a destination but for the duration of the call, the transmission channel is dedicated to reach *only* that destination. Conversely, while such a call is in place, no one else can call either of the connected parties over the same lines. This contrasts with other switched services, such as X.25, which permit not only switching but simultaneous access to multiple destinations over the same transmission channel. This latter capability, known as statistical multiplexing, is independent of switching but is most powerful when both are present.

Call setup time, ranging from a few seconds to over 10 seconds, is relatively slow in a dial network. This is acceptable for voice conversations, but is unacceptably long for those data transaction that will only last a second or less. Transmission speed over the telephone network are also relatively slow. There is ubiquitous access today at speeds of up to 9.6 Kbps, and there are now islands of access to 56 and 64 Kbps dial services. A forthcoming service, currently termed "N X 64" dial service will become available in the next two years.

Dial service can be cost-effective for some bursty traffic. This is because the user does not have to have a call in place unless there is actual data to send. One can hang up when there is no more data to send. However, dial service is not cost-effective for response time sensitive bursty traffic because of limitations in transmission speeds and call setup times.

In order to have the desired protocol flexibility, a protocol insensitive network is needed. The dial network, often called the Direct Distance Dialing network, or DDD network, is a protocol insensitive service. However, there is no automatic alternate routing if there is a failure on the line. Such failures usually will result in the call being dropped, a phenomenon with which we are all familiar. Finally, the user has only an extremely limited ability to manage or monitor a dial network.

LEASED LINES

Leased lines are a very common and popular method of connectivity, particularly for LANs. Leased lines provide a point-to-point or multipoint-to-point (known as "multidrop") service, offering no network switching. Still, leased lines have essentially no call setup time, and very high transmission speeds are readily available. However, leased lines are not cost-effective for bursty traffic because once they are in place the user must pay for each line 100% of the time, whether or not there is traffic present. Leased lines are protocol insensitive, but in and of themselves offer no automatic alternate routing and limited network management by the user.

T1 (OR E1) NETWORKS

One strategy frequently employed to overcome some of the cost and limitations of leased lines is to deploy a T1 multiplexer network. However, it is important to understand that a T1 multiplexer network essentially emulates leased lines. Thus, most of the characteristics of the T1 mux network are very similar to those of leased lines. There is no network switching, so the number of ports and lines emanating from each intelligent endpoint (e.g., LAN or X.25 switch) is exactly the same as it would be with leased lines. Call setup time is again fast, and transmission speeds can be fast or slow. Bursty traffic is not cost effective unless the T1 mux being used is packet-mode in nature, but this introduces delays. T1 circuits, like leased lines, are protocol-insensitive. However, two differences between T1 muxes and leased lines are that T1 muxes perform automatic alternate routing around failed components, and that they allow for comprehensive network management by the customer.

X.25 NETWORKS

X.25, as we have already discussed, provides a switched communications service, and call setup times are relatively fast--typically less than a second. Transmission speeds can be from 1.2 Kbps to E1 rates, but are typically on the order of 64 Kbps. As a packet-mode technology, X.25 is highly cost effective for bursty traffic up to the speeds supported by this technology. In addition, X.25 provides alternative routing and customer network management capabilities.

X.25, though, is not protocol insensitive. All protocols that traverse an X.25 network must first be converted to X.25. This requires software or hardware known as a PAD (Packet Assembler and Disassembler.) PADs are typically available for the most common protocols, but there are several protocols which cannot currently be supported by X.25.

FRAME RELAY NETWORKS

As we have seen, frame relay is a switched technology. It therefore allows any-to-any connectivity without any additional access lines, trunk lines, or transit hops. It offers sub-second call setup time, and the transmission speeds themselves can be very fast: up to T3. Frame relay is extremely cost effective for bursty traffic because it is a packet-mode service. It is protocol insensitive, as long as HDLC-like protocols are being employed. It also provides for alternate routing and for full network management by the user.

VI. STATUS

Where does frame relay stand in terms of standards and products? In the area of standards, the CCITT has completed a service description known as Recommendation I.122, which is sufficiently detailed to allow product implementation to take place. The U.S. standards body, the American National Standards Institute (ANSI), has completed a more detailed draft description of the frame relay frame format. It is anticipated that any early product deployments will be field-upgradeable to reflect any changes to the standards as they evolve. The standards groups are concerned not only with simply adding detail to the existing specifications but to enhancing the specifications themselves in areas such as congestion control.

As for products, frame relay switching systems are now becoming available. Of course, a frame relay switch is only advantageous if it is connected to intelligent endpoints that also support the frame relay standard. US Sprint has announced availability of X.25 packet switches which support a frame relay interface. Several LAN router companies have announced support for frame relay, including two of the largest vendors, Digital Equipment Corporation and cisco Systems Inc. The largest LAN bridge vendor, Vitalink, has also announced a forthcoming frame relay interface. All of these vendors have estimated that their products will be available in early 1991, and further LAN announcements are expected shortly. Frame relay switches will be able to support traffic emanating from any of these devices.

IBM has been active in the frame relay standards sessions because it recognizes the tremendous virtues of transmitting SNA traffic over a frame relay backbone. It is not known at this time, however, when IBM or competing front end vendors will announce a frame relay FEP interface.

VII.CONCLUSION

This paper has been designed to provide the reader with an understanding of the background and technology of frame relay. Over the next few years, the market will see the introduction of many products which take advantage of this technology. It is hoped that this overview will aid network users in evaluating these products in the context of their own requirements.

Application of Digital Video Coding for New Services

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Progress on digital signal processing has had a strong influence on the development of video codecs. These codecs not only digitize the video signals, but also compress them. The picture quality is sufficient for a large variety of applications. A range of codecs, optimized for different applications, is commercially available. Due to decreasing cost and size these devices may interest small businesses or even private users. The digital networks now available in many countries make new audio-visual applications feasible.

This paper presents three examples of applications of different video codecs. A discussion of network requirements and an overview of international standardisation are also included.

1. High Quality Video Transmission

A variety of techniques for TV distribution are in use today. The traditional method is via terrestrial transmitters in the VHF/UHF radio band. In metropolitan areas an increasing number of (tree shaped) coaxial networks (CATV) are to be found. Direct broadcast satellites (DBS) provide a third method of TV distribution.

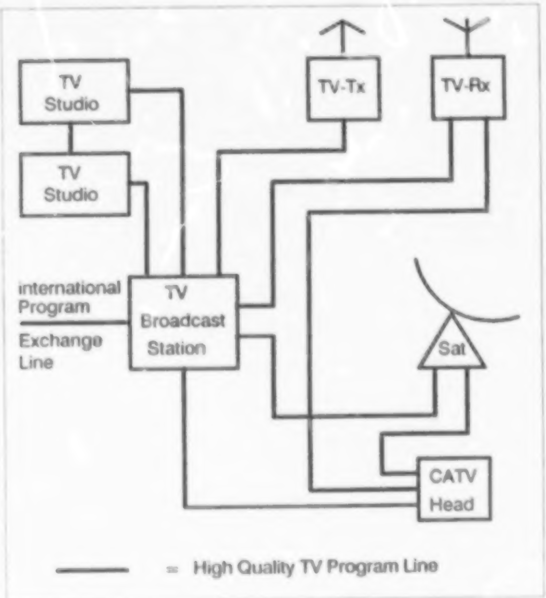

Fig. 1 TV Program Providing System

The nodes of a programme providing system are TV studios, satellite ground stations, TV transmitters, head stations of CATV networks, central switches for international programme exchange etc. Fig. 1 shows a typical arrangement of such a system. Since many systems may be cascaded and quality loss should be kept to a minimum, the interconnection of nodes requires high quality transmission equipment. Analogue transmission modes such as FM, AM-VSB or base band have the disadvantage of accumulating noise which limits the bridgeable distance.

Digital coding of video signals can solve this problem. Once digitized, any distance can be bridged with negligible quality loss. The coder may split the video signal into colour components (R-G-B) or directly digitize the composite signal. The advantage of composite coding is lower price and independence of TV standards. Video quality should comply with CCIR recommendations concerning international TV programme exchange. The system should also provide a minimum of two high quality sound channels for stereo or two-tone applications.

A coder/decoder system for one way transmission has been developed in line with these requirements. Composite coding with 8 or 9 bit resolution, depending on the application requirements, is used. Coder and decoder contain the respective accompanying transmission equipment. To meet the requirements of different applications, two types are available. For short distances of up to 50 km, the optical fibre version is appropriate. Using a single-mode LASER in the 1300 nm range, these distances can be bridged without repeaters. The so-called CMI version offers a standardized CCITT G.703 interface suitable for the H4 level of the plesiochroneous digital hierarchy. The bit rate of the CMI version is 139.264 Mbit/s in accordance with the H4 data rate.

The system has been developed primarily for the aforementioned applications. A range of further applications, requiring high video and audio quality, e. g. videoconferencing, is conceivable.

2. Videoconference Systems

In the early 80s several PTT Administrations carried out field trials to investigate the feasibility of videoconferencing. The Germany PTT, for example, carried out the BIGFON field trial introducing videotelephone/videoconferencing. The optical fibre infrastructure installed for this field trial was used as the basis for the videoconference network in Germany, still operating at 140 Mbit/s.

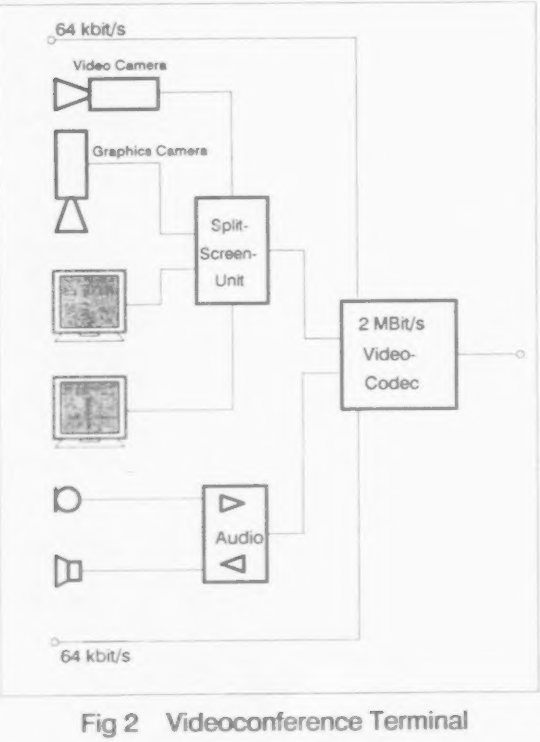

Fig 2 Videoconference Terminal

For international connections, 140 Mbit/s lines were either unavailable or were too expensive for this service. After basic investigations in several countries, the COST 211 group formulated a standard for a 2 Mbit/s video codec. CCITT accepted this in its H.120 Recommendation for the International Videoconference Service. European PTT Administrations launched the European Videoconference Experiment as an international (experimental) service. After the experimental phase, this was changed to the European Videoconference System (EVS). Today, international videoconferences can be carried out between all continents using terrestrial as well as satellite links.

The H.120 codec is based on the European TV standard. At the same time, U.S. companies have developed a codec based on their TV standard and for a data rate of 1.54 Mbit/s . Unfortunately these two types are incompatible, making additional equipment necessary. Some H.120 codecs can operate to the US standard, but the output is still 2 Mbit/s. A remultiplexer then removes the empty time slots in the 2 Mbit/s signal to achieve compatibility.

The first application of the videoconference was for image display of conferees at the remote location, thereby simulating a real conference. The high temporal resolution of a TV system is not required since there is no fast movement . During the experimental phase, customers requested the facility of transmitting still images. Today's videoconference codecs provide one or even two modes of still picture processing. They offer good, or in mode two, excellent spacial resolution for document presentation. Two cursors with adjustable shape and colour are provided, one for each end, to support the still picture application. In addition to these video features, up to two audio channels with standard audio quality, or by using an external device, extended audio quality, are available.

The codec uses the standard PCM30 frame structure and network interface. Two of the 30 available channels may be allocated by the user for any specific application.

To achieve best performance, appropriate audio and video equipment is necessary. A typical videoconference studio contains two cameras to pick up two groups of up to three persons. A split screen unit combines the two pictures on the transmit path. On the receive side the common image is split and displayed on two monitors. A graphics camera which picks up documents and any other still pictures, is optional.

Since the sound system normally uses loudspeakers and microphones, an acoustical echo may occur. The video codec requires approximately 100 msec for image processing and the sound must therefore be delayed by this amount to achieve lip synchronization. This delay, in addition to that caused by the transmission, results in a very disturbing echo. An appropriate acoustic echo canceller is therefore necessary for good audio performance.
Fig. 2 shows the block diagram of a typical videoconference terminal.

Videoconference is not a direct dialling service. It has be booked in advance, a factor which may reduce its availability. As a national solution, German Telekom (PTT) offers direct dialling in the German videoconference network. Most videoconference subscribers are members of a closed user group and do not require connections to outside partners. These groups could therefore install privately operated switches to increase availability.

The normal videoconference is a point-to-point connection. Subscribers may sometimes require connections to several partners simultaneously. A special server, the Multi-Conference-Unit (MCU) provides this facility. The device supports point-to-multipoint as well as real multipoint arrangements. Multipoint facilities are not available as part of the worldwide videoconference service, because they are still in the experimental phase. The problem currently being investigated is, how to control the device and which modes of operation it should cover. A new video codec concept for the videophone as well as for videoconference applications is being discussed by CCITT (H.261). The new codec will provide an inband signalling facility (H.221/H.242) which could facilitate control of the MCU. This may add new features to the videoconference service increasing its versatility and acceptance. Fig. 3 shows a videoconference network using 2 Mbit/s switch and MCU.

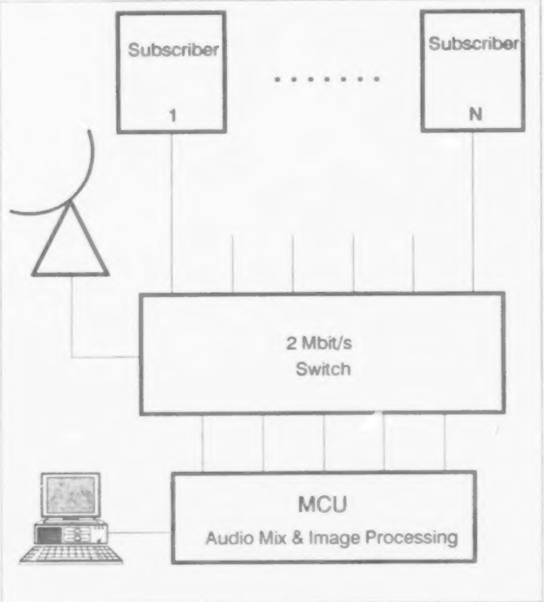

Fig. 3 Videoconference System

3. The Videophone

The experience gained using the H.120 codec and new results from research have stimulated the development of a new codec concept. This new codec should have an adjustable data rate (in steps of 384 kbit/s) and should avoid the disadvantages of its predecessor. One of the major disadvantages of the H.120 codec was that it was based on the European TV standard. CCITT set up an expert group to solve this problem and create a new algorithm.

The group has developed a new video format as a synthesis of the U.S. and European TV standard, the so-called Common Intermediate Format (CIF). Frame size has been derived from the European standard and frame rate from the U.S. standard. The existing pre/postprocessing interfaces are also used to adapt to the desired TV standard. Sophisticated compression techniques such as block coding, motion compensation and filtering in the frequency domain by using DCT are implemented.

The initial aim was to concentrate on a new videoconference codec. Nevertheless, the result obtained also facilitated the realization of a system for videophone applications at bit rates down to 48 kbit/s, with relatively good image quality for pictures without rapid movement. The development of the algorithm is now finished and standardized in CCITT H.261, but additional questions are still under study. The standardization of the aforementioned H.221/H242 inband signalling, however, has not yet been completed.

Several PTT Administrations set up field trials on ISDN and were looking for new applications and services. This provided the opportunity to combine one of the first 64 kbit/s video codecs with the prototype of an ISDN telephone. The result was one of the first ISDN videophones which was unveiled at the TELECOM exhibition 1987 in Geneva. It uses both B-channels of the ISDN subscriber line, one for speech and the other for image. The main application is face-to-face, although an interface for an external camera is available. The video module, with screen and camera, and the optional graphics camera are desk-top devices. Fig. 4 shows the block diagram of this arrangement.

A number of these videotelephones have been manufactured in order to investigate application and user requirements.

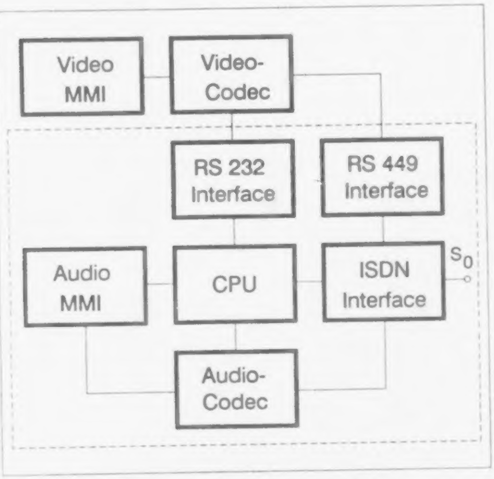
Video MMI
Video-Codec
RS 232 Interface
RS 449 Interface
Audio MMI
CPU
ISDN Interface
S_0
Audio-Codec

Fig. 4 Blockdiagram of the ISDN Videotelephone

The future ISDN videotelephone will be a multi-functional, multi-media device. Face-to-face may be the preferred application for private users or senior management in the business field. Many subscribers will require either a graphics mode or combination with PC applications. To meet the multifarious user requirements, the inband signalling, in accordance with H.221/H242, enables the use of different modes. Mode 0 is the default and less expensive adjustment. It uses only one B-channel for both image (48 kbit/s) and speech (16 kbit/s). Mode 1 uses both B-channels, one for image and the other for speech. For applications requiring higher image quality, mode 3 is available. Again both B-channels are used but with different partitioning. Special signals in the H.221 channel allow the elimination of any delay between the two B-channels. They can thus be combined to a 128 kbit/s signal and then split into 112 kbit/s for image and 16 kbit/s for speech (alternatively 96 kbit/s image and 32 kbit/s speech). In addition to the audio-visual use, medium speed data transmission is possible through the use of the application channel of the H.221 frame. The block diagram in fig. 5 gives an overview on this multi-functional ISDN terminal.

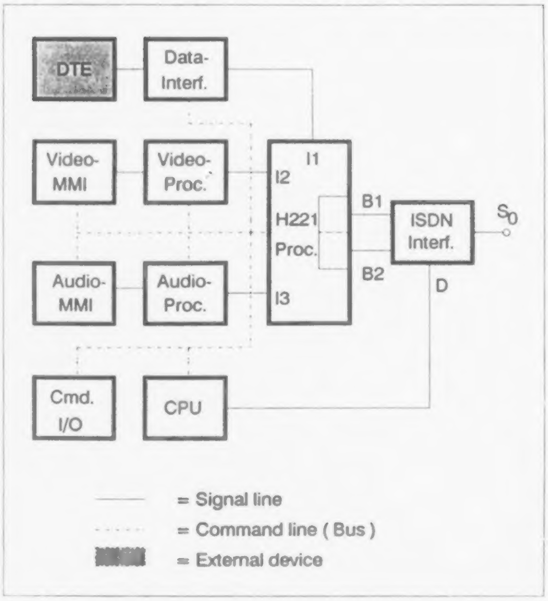
DTE
Data-Interf.
Video-MMI
Video-Proc.
I1
I2
H221 Proc.
I3
B1
B2
ISDN Interf.
S_0
D
Audio-MMI
Audio-Proc.
Cmd. I/O
CPU
= Signal line
= Command line (Bus)
= External device

Fig. 5 ISDN Multi-functional Terminal

"Micro-NET400" Small Message Handling System Running on UNIX

Takeshi Itoh   Tsuyoshi Noda   Kazuhiro Nomoto   Yoichiro Yokoki

NTT PC Communications   Tokyo, Japan

Abstract

NTT PC Communications has developed the "Micro-NET400" a small message handling system that runs on UNIX. Micro-NET400 has an electronic mail facility, a bulletinboard facility and a database access facility. With regard to the electronic mail facility, the Micro-NET400 can serve as Private Management Domain (PRMD) or Administration Management Domain (ADMD) utilizing X.400 protocols .

Protocol handling efficiency and application expandablity are thanks to the system configuration, functional blocking of the software, and a mechanism for interaction between the application process and message handling facilities.

This system will meet user demand for various multimedia applications. It will also provide protocol conversion functions, and work possible other internetwork applications.

1. Introduction

NTT PC Communications is a subsidiary of Nippon Telegraph and Telephone Corporation (NTT). The company provides public message handling services in Japan over a network referred to as NTT PC Network. This network is used to integrate many virtual, private message handling systems on the NTT PC Network. Currently, there are 20,000 users and 3,000 companies in the network.

NTT PC Communications has recently developed a small message handling system which runs on UNIX. We call it the "Micro-NET400", and it has been already proving useful in satellite networks of NTT PC Network. This paper describes features of the NTT PC Network and Micro-NET400.

2. Public message handling services offered by NTT PC Communications

2.1 Services

NTT PC Network supports three basic services.

(1) Electronic mail service based on CCITT X.400 (1984)

(2) Bulletin board service based on recommendation by Japan Postal Administration

(3) Database access service by NTT protocol

NTT PC Network users can integrate their own private networks by combining these three basic services, other optional services and additional products. NTT PC Network service architecture is shown in Fig.2.1.

The public information service is popular with NTT PC Network subscribers. This includes news information bulletin boards, where Japanese newspaper publishers as Mainichi Newspaper and Kyodo Wire Service offer news information. In addition, Nippon Economic Journal offers database service concerning to business and economy in news.

Private networks are also available on NTT PC Network. This includes information/consulting systems for university entrance examination by Kawai-Juku, one of the biggest university prep. schools. High-school students can obtain such information as sample university examinations from the private database and bulletin boards in NTT PC Network.

2.2 System configuration

NTT PC Network has 20 access points around Japan, and the network will be connected with other MHS systems around the world in the near future. Thus, the network will soon be able to provide international electronic mail service.

The NTT PC Network access points are shown in Fig.2.2. and the protocol architecture, based on OSI, is shown in Fig. 2.3.

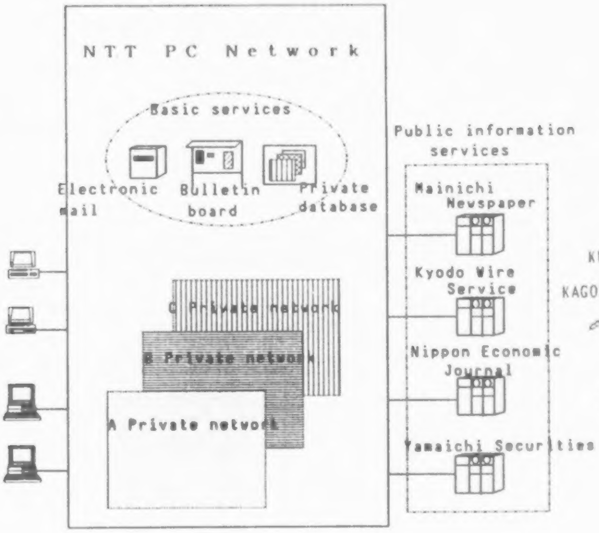
NTT PC Network
Basic services
Electronic mail
Bulletin board
Private database
C Private network
B Private network
A Private network
Public information services
Mainichi Newspaper
Kyodo Wire Service
Nippon Economic Journal
Yamaichi Securities

Fig. 2.1 Service architecture

3. Micro-NET400 concepts

3.1 Concept of Micro-NET400 configuration

Micro-NET400 has a system configuration composed of communication processors, a service processor and other components. The basic concept behind this configuration is described below.

(1) OSI architecture has been adopted as protocols for data transmission and service requests. CCITT international standard X.400 has been adopted as the electronic mail protocol. Furthermore, the Japanese Unified Standard (JUST), announced by Japan Postal Administration, has been adopted as the bulletin board protocol, and NTT protocol has been adopted as the database access protocol.

(2) A special communication processor handles events concerning protocols from physical layer to session layer. This is because the events may be received frequently/asynchronously and should be handled with less time delay than the upper layer events. On the other hand, regarding application layer protocol, events may be transmitted synchronously, and some delay in events handling may be allowed. In this case, the events are handled in the service processor under UNIX.

3.2 Micro-NET400 services

Micro-NET400 is a kind of message handling server for LAN systems. It has local message handling facilities in the LAN, including electronic mail, bulletin board and database access. Therefore, NTT PC Network users can integrate the same private network using Micro-NET400.

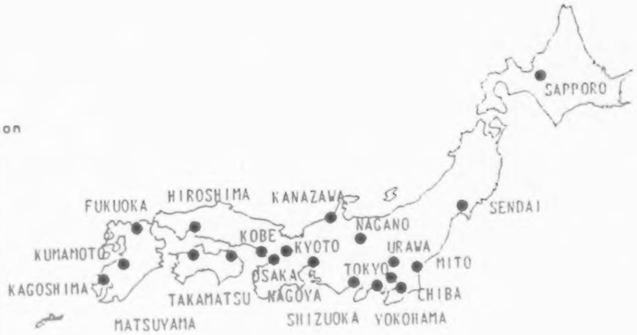
SAPPORO
FUKUOKA
HIROSHIMA
KANAZAWA
SENDAI
NAGANO
KUMAMOTO
KOBE
KYOTO
URAWA
MITO
TOKYO
KAGOSHIMA
OSAKA
TAKAMATSU
NAGOYA
CHIBA
MATSUYAMA
SHIZUOKA
YOKOHAMA

Fig. 2.2 NTT PC Network Configuration

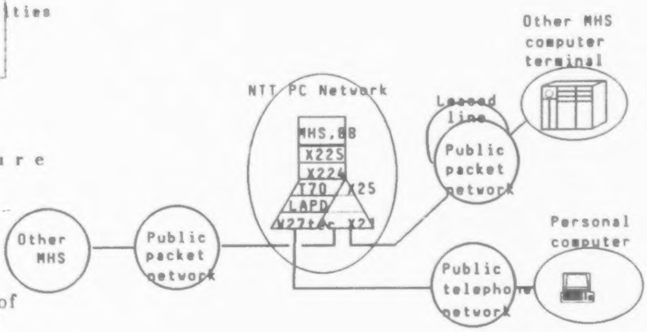
Other MHS computer terminal
NTT PC Network
MHS,BB
X225
X224
T70
X25
LAPD
V27ter
X21
Leased line
Public packet network
Other MHS
Public packet network
Personal computer
Public telephone network

Fig. 2.3 Protocol architecture

An internetworking facility can be created with the electronic mail facility based on CCITT X.400. In this way, Micro-NET400 can communicate with other systems, such as PRMD or ADMD, as well as with other Micro-NET400s.

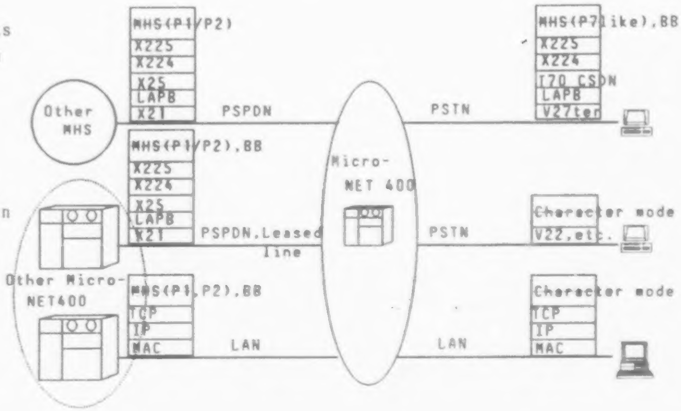
MHS(P1/P2)
X225
X224
X25
LAPB
X21
PSPDN
Other MHS
MHS(P1/P2),BB
X225
X224
X25
LAPB
X21
PSPDN,Leased line
Other Micro-NET400
MHS(P1,P2),BB
TCP
IP
MAC
LAN
Micro-NET 400
PSTN
MHS(P7like),BB
X225
X224
T70 CSDN
LAPB
V27ter
PSTN
Character mode
V22,etc.
LAN
Character mode
TCP
IP
MAC

Fig. 3.1 Protocol architecture for Micro-NET 400

Micro-NET400 supports internal protocols and internet protocols, as shown in Fig.3.1. Micro-NET400 can access NTT PC Network as either PRMD or ADMD.

4. Micro-NET400 system

4.1 System configuration

(1) Loosely coupled multi-processor architecture

UNIX is one of the most common used operating systems. However, it is not very used for real-time event handling due to certain weak points. For example, most of UNIX have no facility to prioritize the processes.

In OSI lower layers, some events may occur asynchronously. Furthermore, upper layer protocol data is divided into several events in the lower layer. The number of events in the lower layers is much larger than that in the higher layer. As a result, it requires too much processing power.

In Micro-NET400, the lower layer protocol events (from physical layer to session layer) are handled in a special communication processor with real-time OS. The upper layer protocol events (application layer) are handled in UNIX. These processors communicate by TCP/IP on LAN, as shown in Fig.4.1.

Bellow is a summary of these processors.

OSI-adapter:
This processor handles events from physical layer to session layer through a packet switched network or a leased line. It is composed of a 16 bit micro computer, a X.25 board, an Ethernet interface board and extension boards. It supports 32 channels on a 9600b/s or a 48kb/s transmission line.

Service processor:
This processor handles events for the application layer on UNIX 4.2BSD, and can accommodate a few OSI-adapters and terminal servers with TCP/IP.

Terminal server/ adapters:
This hardware handles events through a telephone network. It also handles character blocking/de-blocking for the start/stop mode terminals. Furthermore, it handles events from physical layer to session layer for OSI like protocol terminals.

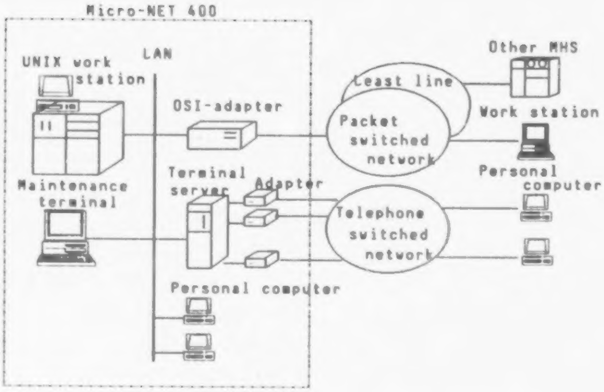

Fig. 4.1 Basic configuration of Micro-NET400

(2) P1/P2 protocol on TCP/IP

Micro-NET400 can communicate with other Micro-NET400s through P1/P2 on TCP/IP. Utilizing the protocol, several Micro-NET400s can be placed on the same LAN, or can be connected with LAN routers or bridges. In this way, a large MHS network can be integrated on a system.

4.2 Software configuration

To efficiently add new facilities, all software should be functionally classified. To accommodate an increasing number of users, the software can be executed on either a single processor or multi-processors.

Thus, Micro-NET400 software is divided among functional modules. Each module is connected with sockets, every module can be executed on either the same processor or a remote processor. The software is divided as described below, and the configuration is shown in Fig.4.2.

(1) Service handling module

This module handles user requests and offers message handling services. In the module, all events are handled in OSI application layer format. The module is divided among three submodules:

(a) Electronic mail service

This submodule controls electronic mail communication from user terminals to mailboxes on disk, and controls communication between mailboxes.

(b) Bulletin board service

This submodule controls bulletinboard access from user terminals, including search, write, read, and delete operations.

(c) Database access service

This service submodule connects user terminals to a database host. Furthermore, it enables a transmission path through a special process that converts the data to adequate code/format for the database.

(2) Communications control module

This service module controls the OSI-adapter with session service primitives. The session service primitives include BCS and BAS session elements. This module also controls personal computer terminals according to protocol like OSI P7. The terminals are controlled with this module through special adapters connected with the same LAN.
The formats of the session service primitives are developed by NTT and are transmitted on a TCP/IP connection.

(3) Start-stop terminal control module

This service module controls start-stop terminals based on menu character string. Here, users request services and receive its responses. This module receives user requests, assembles protocol data units and indicates service primitives to the service handling module. The service handling module controls this module like an OSI-adapter.

Tab. 4.1 Micro-NET400 Hardware

OSI-adapter	Processer	PC-9800(NEC personal computer)
	Protocol	Physical V.35 Datalink LAPB Network X.25 Transport X.224 CLO Session X.225 BCS/BAS
Service processer	Applicable workstation	HP9000-825/835 (Hewlett Packard) NEWS 1810 / 36 (SONY) LUNA (OMRON)
	OS	UNIX 4.2 BSD or 4.3 BSD
	Memory	≧ 8 MB
	Disk	≧ 300 MB
	Protocol	X.400 MHS (1984)

4.3 Architecture for service enhancement

4.3.1 User agent control

Message handling can be generally defined as a kind of interpersonal communication function, and the MHS message content consists of some character strings as text messages. However, since the MHS message content can be handled transparently, many kinds of information can be handled, including facsimile data, software object modules, and other types of binary data. Therefore, MHS messages can be used for the input or output of any process in a computer terminal, or even the MHS system itself.

On Micro-NET400, a special process, called the User Agent Control process (UAC), helps an user application process to interface with message service modules. The UAC architecture is shown in Fig.4.3.

The example of UAC facilities is UAC with mailbox. The UAC serves as a mailbox for service handling modules. The service handling module in the Micro-NET400 delivers mail to the UAC when mail arrives at the user. The UAC interprets the mail protocol data unit, gets parameters/their values, and transfers them to the user application process through a socket. In the opposite direction, the UAC receives parameters/their values, edits mail, and submits it to the electronic mail submodule.

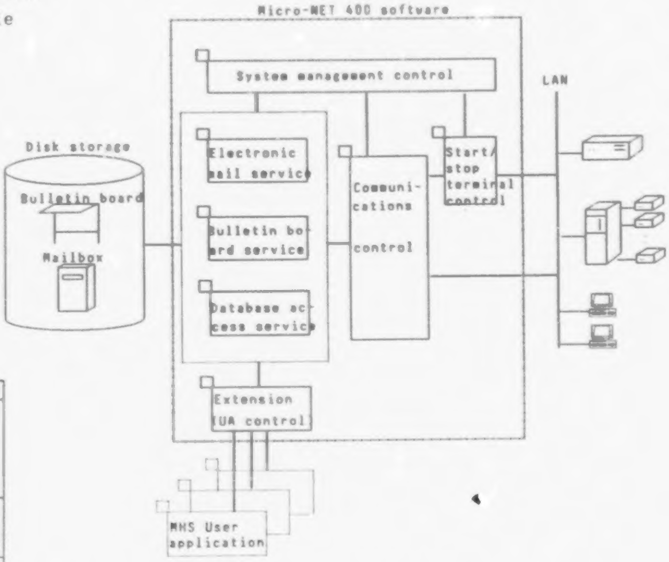

Fig. 4.2 Software configuration for Micro-NET 400

4.3.2 UAC application examples

UAC can be applied many kinds of message handling application. Two examples are shown as follows.

(1) Protocol conversion

In Fig.4.3, user application process A converts data between OSI architecture and X.29, and can easily controls both OSI protocol and X.29 through UAC.

(2) Database access

In Fig.4.3, user application process B controls database access. It receives retrieval inquiry by a mail through UAC, access to database, and returns the answer by a mail.

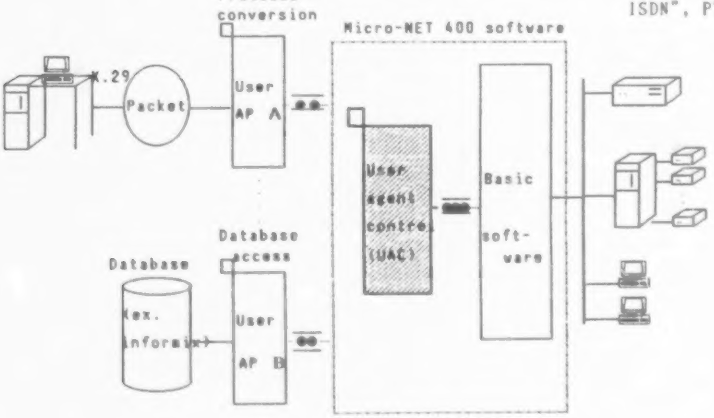

Fig. 4.3 Service enhancement

5. Summary

UNIX will be more popular in business, and message handling system will be needed for various scale companies and various applications. Thus, the Micro-NET400 message handling system has been developed to run on UNIX for multimedia applications. For example, it will be able to provide protocol conversion functions to create gateways to existing telex and facsimile networks, and make possible other internetwork applications.

Utilizing the Micro-NET400 facilities, NTT PC Communications plans to expand the basic services, and offers satellite value-added private networks to users. Furthermore, it plans to start international electronic mail service in the near future, and offers its application products to the subscribers and Micro-NET400 users.

[References]

[1] T.Nakayama, M.Nomura:"Developments of MHS in NTT -Connection of Personal Computers to MHS-", ICCC'86,1986

[2] A.Iwabuchi, Y.Shimazu, M.Nomura, T.Itoh: "Message Communication Network Services for Personal Computers", ICCC'86, 1986

[3] T.Soga, S.Fujiwara, T.Kawahara: "NTT-PCN: Development and Operation", ICCC'88, 1988

[4] Japanese Unified Standard for Telecommunication - Personal Computer: Notification No.971 of Japan Postal Administration

[5] Kazuhisa Hibino, Tomiji Soga, Masatoshi Uchida: "Personal Computer Communication Network System over ISDN", PTC'90, 1990

Comparative study of the use of videoconferencing in the Pacific Area and in the Nordic Countries

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Helsinki University of Technology
Espoo, Finland

ABSTRACT

The result of a videoconferencing user study at Helsinki University of Technology for the main customers of the Helsinki Telephone Company are presented. Also similar study was made in the Helsinki city organization. A special seminar was organized. Questionnaire study was made and the result is presented above. Also PTT-Finland took part in our study. The videoconference is "a must".

1. INTRODUCTION

The paper presents the structure of the videoconferencing system and a presentation of the videoconferencing network in Finland, which includes a 2 Mbps direct-dialling network.

The results of a user study made at Helsinki University of Technology for the main customers of the Helsinki Telephone Company are presented. Experiences with videoconferences and the effects of videoconferencing within companies were discussed in the interviews and opinions were asked. The effects of marketing on the increased use of the service were also evaluated.

The customers who took part in the study can be divided into three groups: those who are enthusiastic and active, those who are not interested and those who do not know anything about the possibilities this service can bring.

In addition to all this mentioned above, an evaluation has been made how the city of Helsinki started to use videoconferencing within the administration. The construction planning department organized a videoconference between separate units where CAD architecture was used. Constructions and landscapes made by CAD were projected on a city plan. A survey was made among the users within the city of Helsinki on applications of videoconferences in administration and the results will be reported.

2. WHY, WHERE, WHEN AND HOW TO USE VIDEO CONFERENCE

2.1 Videoconferencing rooms and their equipment

Videoconference rooms are normally equipped as follows:

- 5 or 6 cameras
- 1 or 2 document cameras
- video monitor for incoming and outgoing pictures
- voice activated video switching
- 5 or 6 microphones with an automatic mixing system
- facsimile available
- VHS and/or U-matic video recorder with Time Base Corrector

Technical parameters:

The coding is as follows:
- 625 lines
- 50 fields/s
- 2048 kbps within Europe; 1544 kbps available

The network is currently star-shaped with a single node in Helsinki. The network consists of: The transmission equipments with the speed of 2048 kbps. Computer based videoconferencing exchange DX200 is in operation.

- gateways for international connections via:
- terrestrial link to Stockholm for connections to Sweden
- the SMS/ECS earth station in Helsinki for connections to Europe
- the Intelsat V/IBS earth station (Owned and run by the Swedish Telecom) in Tanum, Sweden, via terrestrial link to Stockholm for connections to the rest of the world.
- a manual multipoint control unit (MCU) with 10 ports.

TELE-X is a satellite communications system covering Northern Europe (Annex 4). The system gives unique possibilities of communicating directly between offices or with transportable units at remote sites. Typical applications are:

- Videoconferences office to office
- Business TV with fixed or transportable uplinks
- Data communication at bitrates from 64 kbps to 34 Mbps
- Data broadcast to low-cost terminals

In annex 3 there is presented the point to point -principle, multipoint videoconferencing and videoconferencing Finland-USA using Intelsat.

Annex 2 presents the videoconference facilities in Finland and list for contact countries.

2.2 User study of videoconference in Helsinki City

The use of videoconference was studied in the administrative organisation of Helsinki city. The goal of the study was to determine high civil servants' and managers' attitudes of videoconference.

The role of videoconference in city organisation was studied by interviews, inquiries and observations.
Some comments of this large and manifold study:

Low scan video (64 kbps) is good for home terminal. One can effectively do "business" with service people. 64 kbps video is not a conference media, but with it one can e.g. take a life video contact to video seminar. Also he may be a member of inter video meeting (see Annex 4, Santa Claus).

2 Mbps video terminal seems to be some kind of status symbol. Over 90% of participants want it and regard it as useful. 2 Mbps is adequate.

N × 2 Mbps up to 300 Mbps HDTV videoconference:

According to study and after seeing life HDTV picture, architects, engineers and artists saw a new possibility for working with this new media. Multimedia terminal seems to be very important for future administration. It is going to be further developed with computer engineers and architects.

2.3 Videoconference user study at Helsinki Telephone Company

Detailed analysis of the results

Study was made among 53 business customers. We got following result:

Role of videoconference:

	N	%
necessary tool	47	88
produces alternatives	27	51
competition advantage	19	35
improves business image	15	28
training media	15	28
other	5	9
no answer	1	2
total	53	

Importance of aid tools:

	very important 4	3	2	not important 1	tot	ave
document camera	37	10	5	0	52	3.6
telefax	18	24	9	1	52	3.1
data encryption	14	16	17	4	51	2.8
white board	5	25	16	5	51	2.6
video recorder	6	14	21	8	49	2.4
conference secretary	5	13	26	8	52	2.3
PC	2	11	29	9	51	2.1
over head projector	4	8	23	15	50	2.0
prepared tape	2	7	21	18	48	1.8
voice recorder	1	6	18	24	49	1.7
black board	1	3	24	22	50	1.7
slide projector	0	4	23	22	49	1.6
telex	0	1	19	29	49	1.4

Hence videoconference is a necessary tool and produces alternatives. The most important aid tools are document camera, telefax and white board. Naturally data encryption is important, when we are talking about business customers.

Several things were studied:

- effects of using videoconference
- feeling of videoconference situation
- comparing between videoconference and ordinary meeting

Results are presented in Annex1 .

In general videoconference service was regarded as very good. Identification of a person was easy, but picture quality could be better.

Best applications of videoconference were routine meetings (66 %), project meetings (43 %), expert meetings (42 %) and informing (37 %). Internal training, description and advising were also rather good applications.

The need of videoconference

When some company managers in 1989 were asked to evaluate expected need of videoconference at their company the result was as follows:

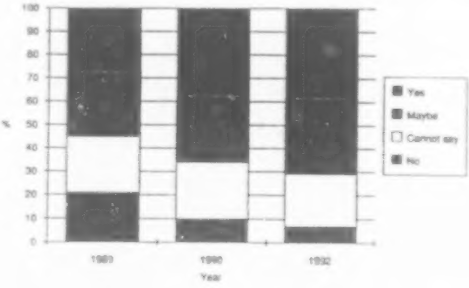

Figure 1. The expected need of videoconference.

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As you can see managers think their company will need videoconference in the future but not urgently. Videoconference is considered important but not as the first one on the priority list.

The use of video studios

The author used the well-known Hammer-Manguria´s grid (Table 1) as a base for the analysis of the influences of videoconferences. The study was done by asking questions to 40 people in telecommunication field. The population consisted of every level of video users. Most important factor was world-wide leadership. Everybody stated that if you have the videoconference facility you may become a world-wide leader.

VALUE

INFLUENCE		EFFECTIVENESS	LEADING	RENEWAL
	TIME	CATALYST OF ACTION 60 %	KNOWLEDGE DELAY REDUCER 70 %	MAKING SERVICE SUPERIOR 75 %
	DISTANCE	RETAKING OF STIPULATED PROFIT 30 %	WORLDWIDE LEADER 100 %	CAPTURER OF MARKETS 60 %
	RELATIONS	REMOVER OF MIDDLEMEN 65 %	DIVIDER OF KNOWLEDGE 60 %	CREATION OF RELATIONSHIPS 50 %

HAMMER-MANGURIA´S GRID
total 40 people

Table 1. Hammer-Manguria´s grid and some HTC-questionnaire results.

70 % (28 persons) of the people thought that very important factor is the influence of knowledge delay reducer. 50% thought that they get new contacts and friends and 65% (26 persons) saw that video is a remover of middlemen. Very important is the effectiveness of videoconference in reducing time. But if you have difficulties in making profit, videoconference is not going to solve your problems. As a conclusion to the study we can state that the most important is the reduction of distance and time in leadership negotiations, marketing and planning. Unfortunately we Finnish video users do no see great value in the influence of videoconference in creation of relationships. But this may be our national character.

The Finns are lonely people. They do not make new contacts easily and they go into the new technology slowly. Despite all we have a high level of knowledge and culture.

I see the international video contacts playing an important role in creating new cultural connections. So you can give information and get information: this is real two way communication. Maybe we could organise Baltic videoconferences and Pacific videoconferences and connect them together.

2.4. Questionnaire study at Helsinki University of Technology

The author made a questionnaire study of the use of videoconference at the course of telecommunications technique in our university. Only 30 of 90 students answered (all who were at the lesson; most active students). The questions were:

The use of videoconference is

	Decrease	No Effect	Increases a little	Incr. a lot	Incr. very much	Mean
catalyst of action	-1	0	1	2	3	1.1
reducer of knowledge delay	-1	0	1	2	3	1.8
making service superior	-1	0	1	2	3	0.8
remaking of stipulated profit	-1	0	1	2	3	0.3
enables world wide leadership	-1	0	1	2	3	1.5
captor of markets	-1	0	1	2	3	0.9
remover of middlemen	-1	0	1	2	3	1.5
divider of knowledge	-1	0	1	2	3	1.7
creation of relationship	-1	0	1	2	3	1.1
			mean of means			1.0

The thirty students part of whom had used videoconference answered the questionnaire as above. The calculated means are on the right of the table. It shows that the students think the most important factors in the use of videoconference are time factors (delay reducer & catalyst of action). Very important factor is divider of knowledge. But if you have lost the markets students don´t believe that you can get them back by using videoconference. We repeated the questionnaire at Helsinki Technical College and the results were quite similar.

2.5. The study at PTC ´91

The author organises a seminar on Tuesday afternoon with Dr David Swift (professor of sociology, University of Hawaii). We make a similar questionnaire study as in our university and we compare the results of different groups and try to make conclusions how to promote the use of information technology and how to remove psychological, social and economical hindrances in the use of videoconference.

3. Videoconference in Europe

You can see from Annex 2 the contacts in Europe. We have about 20 different country contacts in Europe. Most of the traffic is to Sweden and Belgium.

Europe is uniting. Finland is looking for its role in the new Europe but we have no tight language roots to Europe (more to Baltic languages, Hungarian and Siberian; Finnish-Ugrish roots). When building cultural contacts and video connections this should be considered. In Pacific area you have similar cultural islands and they should be connected together through video connections (V-Sat). In videoconference most important factor is the multipoint videoconference.

Studios connected

In Finland we have today more than fifty videoconference rooms (Fig. 2). Most of them are in South Finland. 27 % of sessions are multipoint ones. But studio hours (year 1990) were 70 % multipoint and 30 % two-point. International sessions were 26 % and domestic 74 %. In multipoint connections the number of studios connected together was in most cases (70%) below five as can be seen from the Table 2.

STUDIOS CONNECTED									
%	29	16	25	5	3	4	8	6	3
NUMBER OF STUDIOS	3	4	5	6	7	8	9	10	11

Table 2. Number of multipoint studios connected.

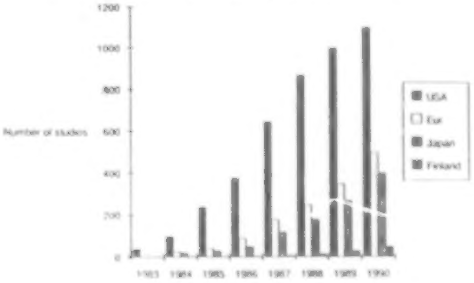

Figure 2. Number of studios in some areas.

International connections

The international connections were to Sweden (69 %), Belgium (13 %), Denmark (4 %), Germany (3 %). Some connections were also to USA, Canada, Japan, Australia, France, Norway, Singapore etc.

Europace

In Europe there is the Europace -education net (Annex 4). Our university is one of the four users in Finland. Most of the use is one way use of teaching programs. Students are not active in questioning.

HDTV

In Europe we have our own HDTV standard (EUREKA-project). Our first HDTV film (28 minutes) using this standard was made 22.7.1990 presenting the solar eclipse. The author has this film here and you can watch it. This scientific film made it possible to follow the blackout more precisely. HDTV video experiments show that you get a totally new equipment for videoconferencing that is dramatically better than the normal 2 Mbit equipments. Video films like this connected to multimedia terminal (tape recorder, 35 mm film, colour printer, conference facilities) give us the possibility to communicate directly from our houses through 300 Mbit digital channel. In Finland we should have in use SDH packet switch network (155-600 Mbit/s) year 1995. That is why the study of multimedia terminals is very important.

EUREKA 1995

According to Eureka 1995 project 1000 HDTV receivers are placed in Europe in 1992 (Barcelona Olympic games) from which at least 50 are placed to Finland. I hope that we can get a common multiuser standard before 1995 when wider use of HDTV receivers is opened in SDH net.

There is a hope that the Japanese and American can join together with Europe to create a common standard. Videoconference tests between Pacific area and Europe are needed. PTC and BTC (Baltic Telecommunication Council) could be the basis for tests like this.

HDTV and shared space

At the last Human Factors in Telecommunications (Torino, Italy, Aug. 1990) -conference there was one interesting presentation about shared space concept (J. F. Gerrissen, J. Daamen, "Inclusion of a Sharing Feature in Telecommunication Services"). They studied possibilities to enrich two-way telecommunication with a similar "sharing" feature as in face-to-face communications. "Shared space" might be in general the direct environment and the present facilities in support of communication, including desks, writing pads and chalk boards. Their initial research addresses the "sharing" of object manipulation and gesturing related to a spoken dialogue, in a situation where pairs of subjects telecommunicate when performing a given task. The video images of the two spatially separated workspaces have been fused so as to represent a virtual shared-workspace at both sites enabling mutual gesturing in relation to all objects present. Actual manipulation is, of course, related to local objects only. This paper proves that if you have a virtual shared space you get the real feeling that you work together at the same place. HDTV improves the videoconference dramatically. We should use the digitally controlled robots and multivideo-HDTV terminals in shared space studios.

4. Videoconference applications today

We made three different studies on the use of videoconference. One was made in a Finnish university where videoconference is used mostly in education. Every user we interviewed thought that videoconference is very powerful in teaching and sending video programs. The Finnish Commercial Broadcasting Company uses videoconference network daily. They produce live programs in Finnish PTT's video studios and broadcast the program from their own studios that are located near PTT's ones. So TV-studio and video studio must be set up near each other.

The difference between a TV-program and a videoconference is diminishing. Videoconference is a multiway live TV-program and people are interested in it. This has to be taken into account when building new HDTV-studios and HDTV packet type video studios.

Multipoint connections are normal in videoconferences. More than 2/3 of conferences have three or more studios connected. The main use of videoconferences in addition to teaching is distance management, negotiations, common work projects (for example in industrial design), material flow management, stock minimisation and common use of stock.

Case garage

Slow scan video is in nationwide use where videophone is used in spare part installation, work guidance, installation manual interpretation and broken part recognition. When a client orders a spare part he can show to the central stock his own drawing of the faulty part or the part itself. This has proved to be very useful and the system is spreading to car dealers.

5. Conclusions

According to our study videoconference is an important tool for companies. It increases competitiveness, makes global management possible, meetings become more effective and you save travelling time. Very important factor is the direct distribution of information. Also the face-to-face communication improves the human communication.

There are of course a lot of negative factors as well. Most of them are technical: quality of video picture is poor, equipment are difficult to use, people are confused when they come to videoconference (strange situation), the conference time is technically limited and you don´t know the behaviour of people at videoconference, distances to conference rooms can be long and many people like travelling. The videoconference makes human being more and more effective but there is a limit to stress which can be seen from the fact that some people want to stop using videoconference because of the extra stress.

References

1. Internal videoconference studies.
2. M. Schrey-Hyppänen, *Videoconference as a Teleservice*, Diploma Thesis for Helsinki University of Technology (in Finnish), 1990.
3. J. Järvenpää, ***Need Evaluation of Videocommunications in Public Organisations***, Diploma Thesis for Helsinki University of Technology (in Finnish), 1990.
4. A. M. Clarke, J. Leppänen, J. Manzanaro, F. Papa, *Usability of Videocommunications in the RACE ISSUE Project*, 1990.
5. Different brochures of Telecom Finland, Helsinki Telephone Company and Helsinki University of Technology.

Annex i

Effects of using video conference

	1	2	3	4	5	tot	ave
use of time	0	0	2	18	33	53	4,6
method of working	0	0	8	30	15	53	4,1
planning of meetings	0	1	20	19	13	53	3,8
intensity of meeting	0	6	17	19	10	52	3,6
decision making	0	2	26	16	8	52	3,6
negotiations	1	7	15	20	8	51	3,5

Situation in video conference is

	N	%
interesting	36	67,9
like ordinary meeting	16	30,2
widening	14	26,4
exciting	8	15,1
odd	4	7,5
freeing	4	7,5
other	4	7,5
shying	2	3,8
irritating	1	1,9
relaxing	1	1,9
no answer	1	1,9
frightening	0	0,0
total	53	

Comparison between video conference and ordinary meeting

	1	2	3	4	5	tot	ave
begins precisely	1	1	3	23	25	53	4,3
better scheduled	1	2	5	27	18	53	4,1
more effective	0	2	17	23	11	53	3,8
better equipped	1	4	16	21	11	53	3,7
more pertinent	1	3	21	22	6	53	3,5
faster organized	4	13	9	14	13	53	3,4
more flexible	6	20	16	10	1	53	2,6

Evaluation of services

	1	2	3	4	5	tot	ave
general opinion of video conf.	0	1	6	28	15	50	4,1
quality of connection	1	2	15	25	7	50	3,7
reliability of connection	1	3	19	17	11	51	3,7
functionality of charging	0	0	19	9	5	33	3,6
service of supplier	2	3	11	21	3	40	3,5
knowledge of supplier	2	1	18	14	4	39	3,4
clearance of charging	0	1	21	7	4	33	3,4
customers training	0	5	22	17	3	47	3,4
possibility of international conne	3	8	10	16	7	44	3,4
education of supplier	2	2	17	15	2	38	3,3
informing of problems	1	7	19	13	2	42	3,2
rightful of charging	1	5	20	8	3	37	3,2
overall knowledge	0	7	21	12	1	41	3,2
subscription of connection	3	8	16	13	4	44	3,2
marketing of service	0	9	24	8	2	43	3,1
possibility of data encryption	3	10	15	10	4	42	3,0
introduction of applications	0	13	20	7	2	42	3,0
introduction of alternatives	0	11	20	5	2	38	2,9
availability of service	4	16	17	10	2	49	2,8
density of public studios	9	21	7	7	2	46	2,4
charges of use	15	15	14	1	0	45	2,0
cost of equipment	13	22	10	1	0	46	2,0

Features

	1	2	3	4	5	tot	ave
identification of a person	0	2	8	20	23	53	4,2
voice recognition	0	4	8	23	18	53	4,0
picture quality	1	2	15	26	9	53	3,8
voice quality	0	3	18	23	9	53	3,7
recognition of documents	1	10	15	19	8	53	3,4
recognition of expression	3	7	14	23	6	53	3,4
recognition of lip movement	0	13	13	20	6	52	3,4

Annex 2

FINLAND

PUBLIC STUDIOS,

TELECOM FINLAND

Booking office:
tel. 358 0 7042213
fax 358 0 7042020

HELSINKI TELEPHONE COMPANY

Booking office:
tel. 358 0 606 700
fax 358 0 606 3665

HELSINKI UNIVERSITY OF TECHNOLOGY

CENTRE FOR CONTINUING EDUCATION
EuroPACE Centre
Otakaari 1, Y426B
02150 ESPOO
tel. 358 0-451 4027
fax 358 0-451 4045

CONTACTS

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Portugal
Spain
Sweden
Switzerland

AUSTRALIA

CANADA

USA

ASIA

THE FAR EAST

Hong Kong
Japan
People's Republic of China
Singapore
Taiwan
Turkey

PUBLIC STUDIOS OWNED AND RUN BY TELECOM FINLAND 1.2.1990

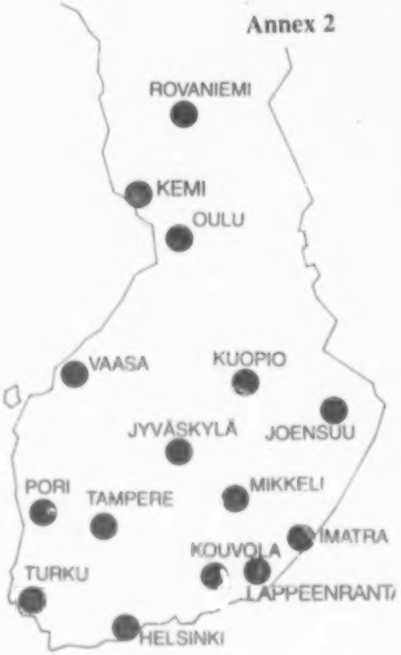
Videoconferencing has been selected as a key area of development in the unification of Europe. Telecom Finland is an active participant in the development of international videoconferencing and handles all international videoconferencing connections in Finland.

Telecom Finland can today arrange videoconferences from Finland to almost every European country, the USA, Canada, Japan, Singapore, Hong Kong and Australia.

Videoconferencing increasing rapidly.

Videoconferencing is in extensive use in Finland, and its usage doubles from year to year. This is no wonder, given Finland's large land area and remote geographical location. In short: videoconferencing moves information, not people – leading to saved time and increased efficiency.

A multipoint videoconference arranged by Telecom Finland can include up to 12 studios in Finland and abroad. Today, every major city in Finland features a Telecom videoconference studio.



Videoconferences make business communication more efficient and give it a greater range. Distances lose their meaning when meetings can be carried out easily by using video and teletechnology. Videoconferences are rapidly becoming popular in Finland as well as in other countries.

You can meet your collegues or customers in other cities, countries or continents – without leaving your office.

Arranging meetings is fast and easy when travelling is no longer necessary. And after an efficient meeting you will be back at your own desk in a couple of minutes.

Investments in videoconferences are extremely profitable. Just think about working efficiency, or savings in travel and meeting times. The time spent on travel can now be used in profitable work.

Videoconferences are an important part of the constantly developing product selection of HTC. We offer you our whole expertise in this rapidly developing area.

- We take care of the total planning and construction of rooms and network solutions
- We provide necessary instructions of use, and training
- We also provide reliable and fast maintenance in problemsituations.

Telecom Finland is the largest telecommunications operating company in Finland, and the only one that operates nationwide. Telecom Finland also handles the country's international telecommunications.

Telecom's budgeted turnover for 1990 is USD 11 billion. The number of personnel is 11 000.

Telecom Finland provides **local telephone services** throughout most of Finland, and operates the national **trunk telephone network** on a sole basis. In addition Telecom operates two joint **Nordic NMT cellular mobile telephone networks**, together with a nationwide **radiopaging service**. It is also presently constructing a nationwide digital cellular mobile system, as part of the **pan-European GSM network**. In terms of mobile telephone density, Finland ranks 4th in the world.

In the field of **data transmission**, Telecom offers both packet switched and circuit switched services, according to customer needs. Data and text transmission services are also offered to mobile telephone subscribers. Telecom's **value added data services** include state-of-the-art global services, such as X 400. Finland also ranks high in **international direct dialling**, with over 190 countries directly accessible from any point in the public telephone network. **Telex** connections are available to all corners of the world.

The national **ISDN** trial network was taken into use in 1989. Telecom Finland is rapidly digitalizing its local and trunk networks, and equal progress is seen in the installation of **fibre optic systems**. Telecom is also a forerunner in **videoconferencing**, with a nationwide network of studios for both national and international videoconferences.

Telecom Finland's basic operating principles can be listed as: customer orientation, result responsibility, businesslike operation and alertness to market trends. Features which will become increasingly important to companies operating in a unifying Europe.

TELECOM FINLAND PROVIDES YOU WITH ALL YOU NEED IN VIDEOCONFERENCING

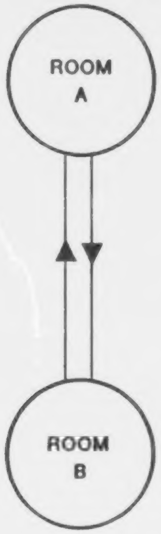
World-wide modern telecommunications network which facilitates
- domestic and international videoconferences
- two-point and multi-point videoconferences

Full service containing:

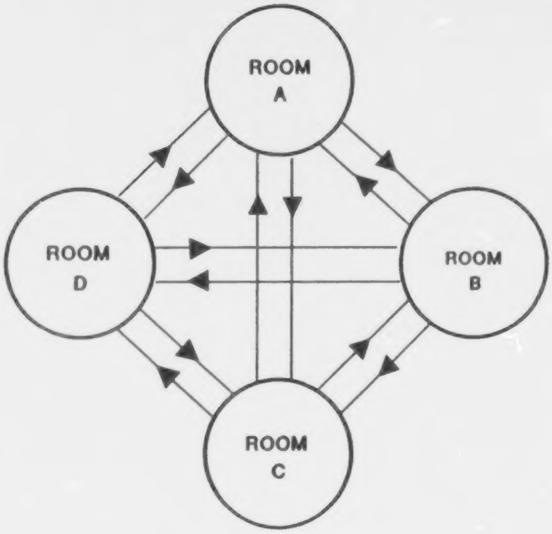
- videoconferencing customer connections
- studio equipment, fixed and portable ("rollabout")
- codecs
- consulting
- training
- service and maintenance

Annex 3

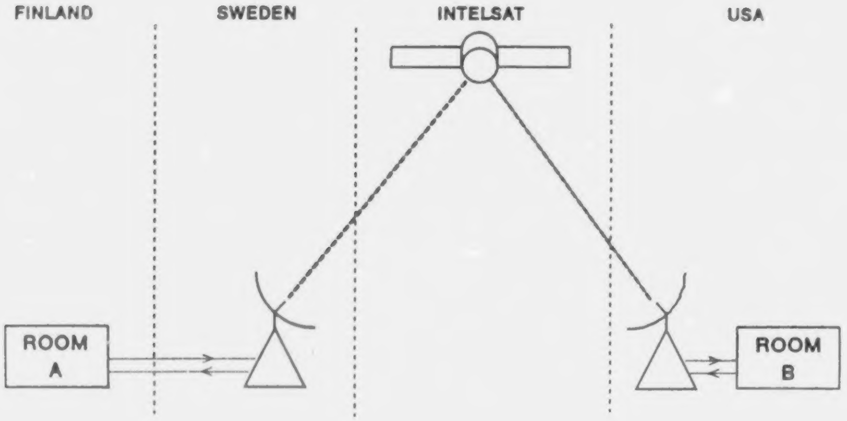
POINT-TO-POINT VIDEOCONFERENCING


ROOM
A
ROOM
B

MULTI-POINT VIDEOCONFERENCING


ROOM
A
ROOM
D
ROOM
B
ROOM
C

VIDEOCONFERENCING FINLAND - USA


FINLAND
SWEDEN
INTELSAT
USA
ROOM
A
ROOM
B

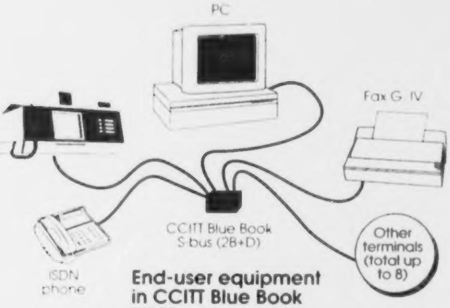
Annex 4

Santa Claus Happy with Video Phone

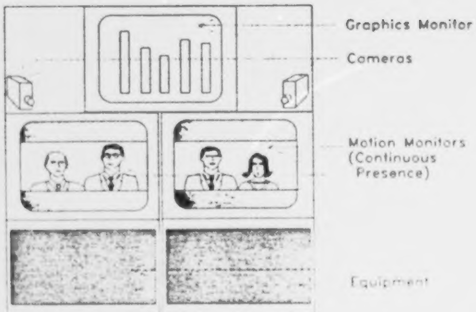
TELE-X

USER TERMINALS

- Most commonly used terminals are for 64 kb/s and/or 2 Mb/s
- Other bitrates also available
- Antenna size 1.8 - 2.5 m
- User interface
  64 kb/s: X.21, V 35
  2 Mb/s: G.703


PC
Fax G IV
CCITT Blue Book
S-bus (2B+D)
Other terminals (total up to 8)
ISDN phone

End-user equipment in CCITT Blue Book ISDN environment


Graphics Monitor
Cameras
Motion Monitors (Continuous Presence)
Equipment

Dual Camera/Triple Monitor VTC Facility

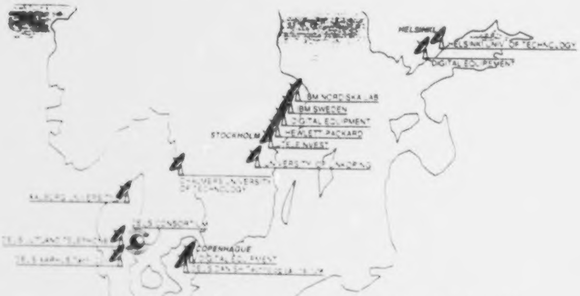
EuroPACE

PACECOM

EuroPACE, the European Programme of Advanced Continuing Education, is set up to serve European industry, universities and research centers. Satellite transmission of courses, reportages from conferences and specially orgnized live events assure rapid, widespread distribution. Written material and - sometimes - software to support the videos are distributed prior to the transmissions. A computer conferencing system is operated for student-teacher and student-student interactivity and communication. The educational activity is normally based on a combination of these media and tools.

At present, the following fields are covered, dealing with or closely related to information technology, where a strong demand for continuing education in Europe has been identified:

- Advanced Manufacturing Technologies (AMT)
- Expert Systems / Artificial Intelligence (ES/AI)
- Microelectronics (ME)
- Software Engineering (SE)
- Telecommunications (TC)
- Technology Management (TM)


HELSINKI
HELSINKI UNIV OF TECHNOLOGY
DIGITAL EQUIPMENT
IBM NORDISKA LAB
IBM SWEDEN
DIGITAL EQUIPMENT
HEWLETT PACKARD
STOCKHOLM
CHALMERS UNIVERSITY OF TECHNOLOGY
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SOME SCANDINAVIAN
EUROPACE SITES

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NTT's ISDN Services: Customer Interest and Applications

Naoki Takeda and Akihiko Kondo
Nippon Telegraph and Telephone Corporation (NTT)
Tokyo, Japan

1. ABSTRACT

NTT introduced its ISDN services, called INS-Net services, in April 1988. Since then, the number of lines and customers have steadily grown, and ISDN applications have gradually expanded. This paper describes ISDN applications and customer benefits, and examines the future prospects of ISDN services at NTT.

2. OVERVIEW

NTT started its commercial ISDN service with a basic rate interface, called INS-Net 64, in April 1988. A primary rate interface, called INS-Net 1500, was intorduced in June 1989. (Figure 1)

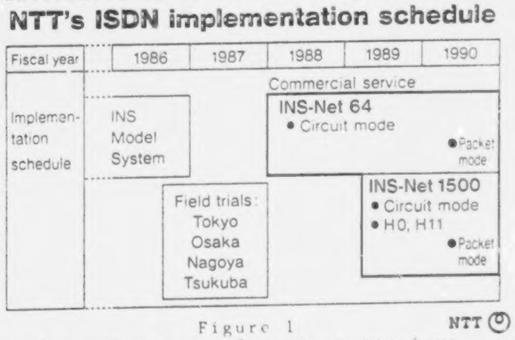
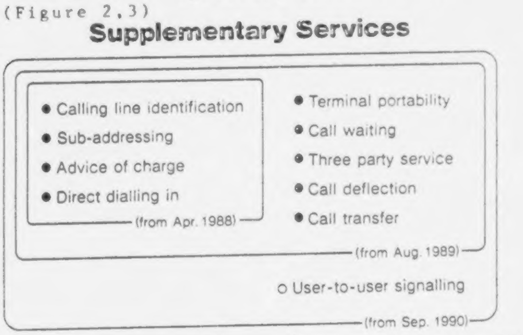


Figure 1

As for INS-Net supplementary services, "flexphone service", consisting of CW, 3P, CD, CT was offered in August 1989, and User-to-user signalling in June 1990. (Figure 2,3)



Supplementary Services

- Calling line identification
- Sub-addressing
- Advice of charge
- Direct dialling in

(from Apr. 1988)

- Terminal portability
- Call waiting
- Three party service
- Call deflection
- Call transfer

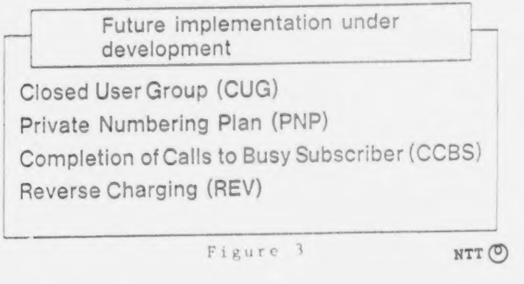
(from Aug. 1989)

○ User-to-user signalling

(from Sep. 1990)

NTT

Figure 2



Supplementary Services

Future implementation under development

Closed User Group (CUG)
Private Numbering Plan (PNP)
Completion of Calls to Busy Subscriber (CCBS)
Reverse Charging (REV)

NTT

Figure 3

Since start of commercial ISDN services, both the number of lines and customers have steadily grown. NTT has also gradually expanded the INS-Net service area, based on a policy aimed at making INS-Net services available wherever there is a customer demand, from the spring of 1990. Furthermore, in June 1990, NTT added packet mode service to INS-Net services. Resulting from the steadily improvement of services and expansion of service area, the number of INS-Net subscriber lines exceeded 10,000 in May 1990. (Figure 4)

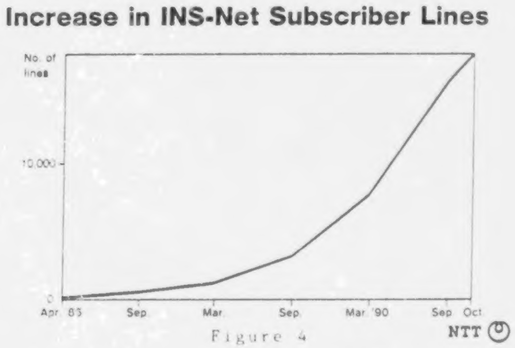


Figure 4

The increase in customers has led to more diversified ISDN applications. NTT has been focusing efforts to develop ISDN applications in 4 main fields of the telecommunications market: business use, public use, home use, and global use.

3. MAIN APPLICATIONS OF INS-Net SERVICES FOR BUSINESS USE

3.1 INS-Net SERVICE FOR BUSINESS USE

INS-Net services, which enable high-speed and high-quality communications, are now used in various fields of business. The following are the main applications of INS-Net services for business use.

3.2 VOICE COMMUNICATIONS

INS-Net services offer AM broadcasting level high-fidelity voice communication in the 50Hz-7kHz band, which is twice or more as high as that of existing analog networks. This capability makes possible high-fidelity voice transmission of live radio broadcasts from location, as well as

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remote stenographing systems. With the high-fidelity voice transmission service, if a radio station wishes to broadcast from a baseball stadium, the equipment is connected via INS-Net. The 7kHz voice CODEC units in both sites achieve high-fidelity voice communication. (Figure 5, Photograph 1)

Live Radio Broadcasts from Location

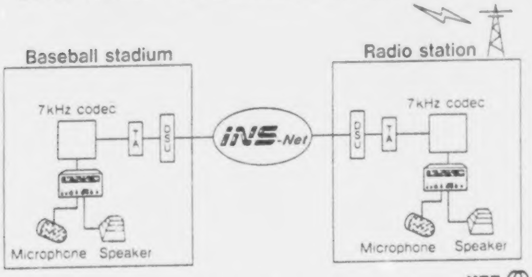

Baseball stadium
Radio station
7kHz codec
T A
DSU
INS-Net
DSU
T A
7kHz codec
Microphone
Speaker
Microphone
Speaker

Figure 5

NTT

The stenographing application would enable, for example, a conference to be transmitted in high-fidelity voice to a stenographer's office. By using the 7kHz voice CODEC unit, a stenographer can receive the transmitted information clearly and accurately from a remote location. (Figure 6)

Remote Stenographing System

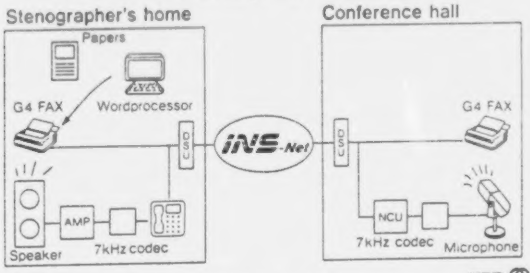

Stenographer's home
Conference hall
Papers
G4 FAX
Wordprocessor
DSU
INS-Net
DSU
G4 FAX
AMP
Speaker
7kHz codec
NCU
7kHz codec
Microphone

Figure 6

NTT

3.3 HIGH-SPEED COMMUNICATIONS

Continuing technological advances, along with the growth of the "information society" have led to a growing demand for high-speed communications systems. INS-Net services, G4 facsimile terminals and floppy disk data transfer terminals are helping to meet this demand. These recent developments have contributed to a sharp reduction in the cost of communication services. Among them, the G4 facsimile communication system is now one of the most popular applications of INS-Net services. About five thousands G4 facsimiles are currently being used in Japan. G4 facsimiles can transmit a piece of A4 size paper in 4 seconds, and characters and photographs transmitted through G4 machines retain a higher quality than G3 machines. (Figure 7)

G4 Facsimile Communication System for Municipal Office

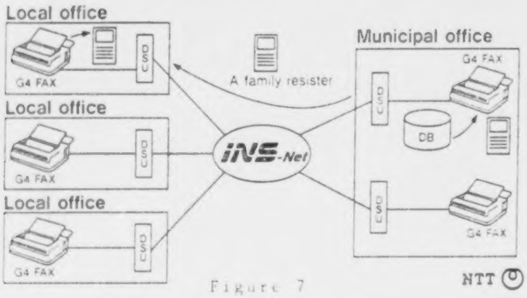

Local office
G4 FAX
DSU
Local office
G4 FAX
DSU
Local office
G4 FAX
DSU
A family resister
INS-Net
Municipal office
DSU
G4 FAX
DB
DSU
G4 FAX

Figure 7

NTT

Floppy disk data transfer terminals, which are also becoming increasingly popular in Japan, can transmit 1 Mbyte of data in only 3 minutes. (Figure 8, Photograph 2)

Floppy Disk Transfer System

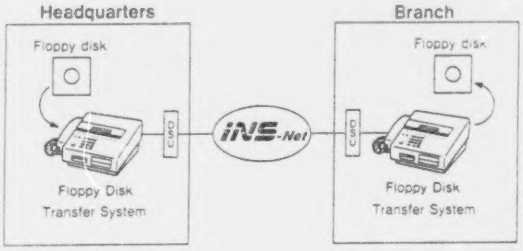

Headquarters
Branch
Floppy disk
Floppy disk
DSU
INS-Net
DSU
Floppy Disk Transfer System
Floppy Disk Transfer System

Figure 8

NTT

Moreover, INS-Net services used in the application of CAD/CAM transfer systems are capable of high-speed transmission of CAD/CAM data. (Figure 9)

CAD/CAM Data Transfer System

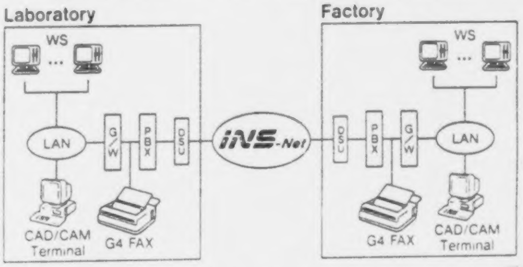

Laboratory
Factory
WS
WS
LAN
G/W
PBX
DSU
INS-Net
DSU
PBX
G/W
LAN
CAD/CAM Terminal
G4 FAX
G4 FAX
CAD/CAM Terminal

Figure 9

NTT

3.4 VISUAL COMMUNICATIONS

Video transmissions via INS-Net services are used both for video conferencing systems and remote monitoring systems. The remote monitoring system is particularly useful for banks and storekeepers. Banks use the system for monitoring Automatic Teller Machines (ATMs) from a centralized monitoring center after regular banking hours. (Figure 10)

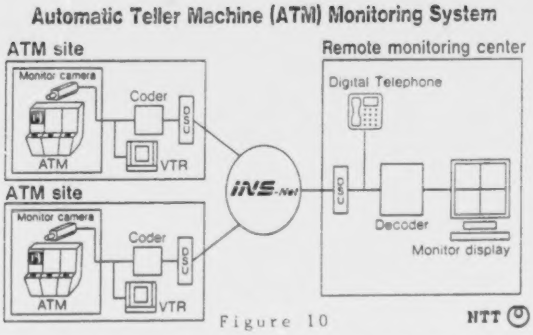

Automatic Teller Machine (ATM) Monitoring System
ATM site
Monitor camera
Coder
DSU
ATM
VTR
ATM site
Monitor camera
Coder
DSU
ATM
VTR
INS-Net
Remote monitoring center
Digital Telephone
DSU
Decoder
Monitor display

Figure 10

Storekeepers can use the system to monitor remote stores from monitoring centers. (Figure 11)

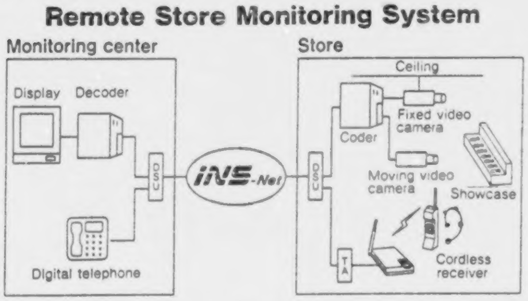

Remote Store Monitoring System
Monitoring center
Store
Display
Decoder
DSU
Digital telephone
INS-Net
DSU
Ceiling
Coder
Fixed video camera
Moving video camera
Showcase
TA
Cordless receiver

Figure 11

INS-Net services are also used in the application systems of NTT's digital videotex, called Hi-Captain. Digital videotex systems utilizing INS-Net capabilities can realize a high-quality still image transmissions. This system is now being employed advantageously in the used car industry as a used car information retrieval system. (Figure 12)

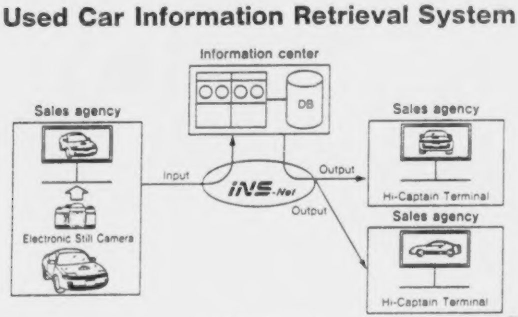

Used Car Information Retrieval System
Information center
DB
Sales agency
Electronic Still Camera
Input
INS-Net
Output
Output
Sales agency
Hi-Captain Terminal
Sales agency
Hi-Captain Terminal

Figure 12

3.5 STRATEGIC INFORMATION SYSTEMS

INS-Net services are also effective for constructing economical Strategic Information Systems (SISs). For example, they are used for POS data transmission system. These can be employed to assist users in reviewing customer information collected from various departments, and for developing corporate strategy. (Figure 13)

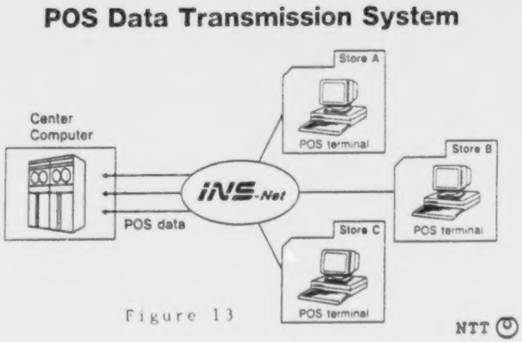

POS Data Transmission System
Center Computer
POS data
INS-Net
Store A
POS terminal
Store B
POS terminal
Store C
POS terminal

Figure 13

4. PRESENT STATUS OF INS-Net SERVICES

As of the end of October 1990, the number of INS-Net 64 subscriber lines was about 14,650, accomodating 3,350 customers, while that of INS-Net 1500 was about 315, accomodating 105 customers. (Figure 14)

Scale of INS-Net Services

(As of the end of Oct. 1990)

	INS-Net 64	INS-Net 1500
Area	460	
Number of customers	3,350	105
Number of subscriber lines	14,650	315

Figure 14

The monthly increase of INS-Net 64 subscriber lines in October was about 1,600, and that of INS-Net 1500 was 30. Although customers have been predominantly interested in the systems's cost effectiveness, the new value-added applications, which are not impossible with conventional networks, are also appreciated. (Figure 15)

Customer Benefits and Applications

1. Cost efficient integrated network
2. Enhanced services network

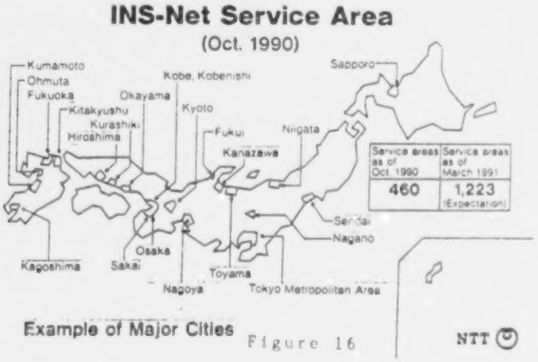
Figure 15

With regard to service area, INS-Net became available in about 460 areas out of about 4,400 areas all over Japan as of October 1990.

5. MILESTONES IN THE EXPANSION OF NTT'S INS-Net SERVICES

5.1 NATIONWIDE COVERAGE OF INS-Net SERVICES

In order to promote the development of nationwide ISDNs, NTT is striving to make INS-Net services available all over Japan. As part of this effort, NTT decided to offer INS-Net services wherever there is a customer demand, from the spring of 1990. This measure has proven to be a popular one, and has accelerated the growth of INS-Net subscribers. NTT plans to expand INS-Net service area to about 1,200 areas out of about 4,400 areas all over Japan by the end of March 1991, according to future demand forecasts. At that point, 90% of the population will have access to INS-Net services. (Figure 16)

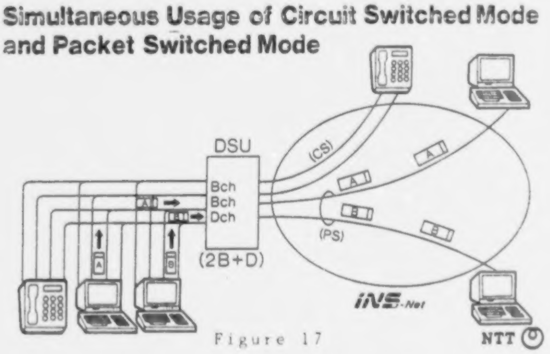

INS-Net Service Area
(Oct. 1990)

Kumamoto
Ohmuta
Fukuoka
Kitakyushu
Hiroshima
Kurashiki
Okayama
Kobe, Kobenishi
Kyoto
Fukui
Kanazawa
Niigata
Sapporo
Sendai
Nagano
Kagoshima
Sakai
Osaka
Nagoya
Toyama
Tokyo Metropolitan Area
Service areas as of Oct. 1990
460
Service areas as of March 1991
1,223
(Expectation)
Example of Major Cities
NTT

Figure 16

5.2 START OF PACKET MODE SERVICE

The simultaneous use of the circuit-switched and packet-switched modes over the same subscriber line is one of the most important features of INS-Net services. (Figure 17)


Simultaneous Usage of Circuit Switched Mode and Packet Switched Mode

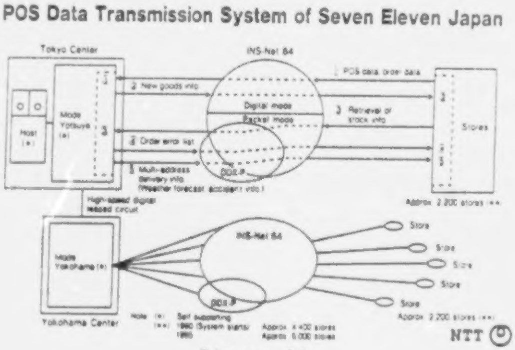
DSU
Bch
Bch
Dch
(2B+D)
(CS)
(PS)
A
B
INS-Net
NTT

Figure 17

Customer demand for packet mode has been very high due to its effective data transmission capabilities, using terminal multiplexing and packet multiplexing. To meet this demand, NTT introduced packet mode in both B and D channels of INS-Net services. Customers have found packet mode to be an effective tool for data communication. As of October 1990, the number of B and D channels used for packet mode was about 400 and 800, respectively.

5.3 THE SEVEN ELEVEN JAPAN ISDN SYSTEM

In June 1990, NTT accepted an order for about 4,400 lines of INS-Net from Seven Eleven Japan, which is one of the biggest convenience chain stores in Japan. The policy to make INS-Net services available wherever there is a customer demand, and the start of packet mode service encouraged Seven Eleven Japan to introduce INS-Net services. The company plans to utilize 4,400 INS-Net lines for the POS data transmission system between the host computer of the center and the POS terminals of 4,400 stores throughout Japan, from the spring of 1991. In this system, data of large volume, such as order data and goods information, will be transmitted in digital mode. Data of less volume per line hold time, such as stock information of goods, will be transmitted in packet mode. (Figure 18)


POS Data Transmission System of Seven Eleven Japan

Tokyo Center
INS-Net 64
Host (*)
Mode Yotsuya (*)
1 POS data order data
2 New goods info
Digital mode
Packet mode
3 Retrieval of stock info
4 Order error list
5 Multi-address delivery info (Weather forecast accident info)
DDX-P
Stores
Approx. 2,200 stores (**)
High-speed digital leased circuit
Mode Yokohama (*)
Yokohama Center
Store
Store
Store
Store
Store
Approx. 2,200 stores (**)
Note (*) Self supporting
(**) 1990 (System starts) Approx. 4,400 stores
1995 Approx. 6,000 stores
NTT

Figure 18

This system enables Seven Eleven Japan to exchange information effectively between the headquarters and stores, and to efficiently coordinate the management of a lot of stores.

6. PROMOTION OF ISDN FOR PUBLIC USE

6.1 INSTALLATION OF ISDN PUBLIC TELEPHONES

NTT first started to offer ISDN public telephone in April 1990. This telephone, connected to INS-Net 64, has both an analog and a digital port. (Photograph 3) Portable ISDN terminals such as a portable PC, can be plugged into the digital port of the phone, enabling high-speed data transmissin between the terminal and a host computer connected to INS-Net. Although, there are few ISDN portable terminals available today, the growing popularity of portable terminals is expected to increase the demand for ISDN public phones, due to the advantages this remote transmission capability has for business use. NTT plans to install about one thousand of the phones along streets, and in hotels, airports, and so on, mainly in the metropolitan areas, by the end of March 1991.

6.2 MARKET FEASIBILITY STUDY OF VIDEO AND VOICE MESSAGING SYSTEM

The use of video as a communications medium has been growing in popularity among our users. Also, our present message dialing service has been more and more popular these days, and it attracts over 15 million calls per month. Taking them into consideration, in October 1990, NTT started a market feasibility study of the video and voice messaging system. As part of this study, we installed several videophones in the Tokyo metropolitan area. (Photograph 4) This system has three functions: Notice board, Message board, and Private message box. For example, the Notice board enables customers to input the messages with video at one videophone and to output it from another, using secret numbers. (Figure 19)

Video and Voice Messaging System

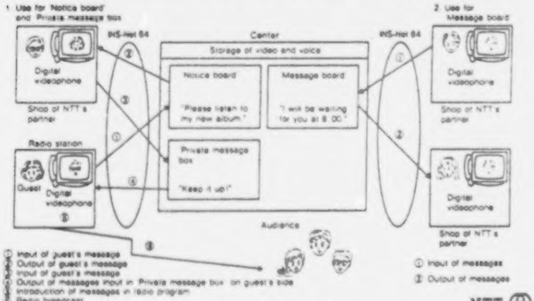

1 Use for 'Notice board' and Private message box
2 Use for Message board
INS-Net 64
Center
Storage of video and voice
Notice board
"Please listen to my new album."
Message board
"I will be waiting for you at 8:00."
Private message box
"Keep it up!"
Digital videophone
Shop of NTT's partner
Radio station
Guest
Audience
① Input of guest's message
② Output of guest's message
③ Input of guest's message
④ Output of messages input in Private message box on guest's side
⑤ Introduction of messages in radio program
⑥ Radio broadcast
① Input of messages
② Output of messages

Figure 19

This test will enable NTT to examine both the feasibility of the system itself, as well as the potential of ISDN visual communications in the public market. NTT will continue this study until the end of March 1991.

7. PROMOTION OF ISDN FOR HOME USE

In Japan, as in other countries, ISDN services are now used mainly for business conmmnications. However, NTT plans to promote INS-Net 64 services for home use, due its relative cost effectiveness compared with conventional telephone service. (Figure 20,21,22)

INS-Net 64 Service Charges

Subscription charge (Non-recurring)			¥ 800
Installation charge (Non-recurring)			¥72,000
Monthly charges	Line charge	Business use	¥ 3,630
		Residential use	¥ 2,830
	Equipment connection charge		¥ 60
	Equipment rental charge		¥ 1,700
	Packet mode surcharge	Per one B channel	¥ 3,500
		Per one D channel	¥ 1,000
	User-to-user signalling		———
Call charges	Telephone mode		Same as for ordinary analog telephone
	Digital mode (64kb/s)		(Charge unit : ¥10) 180sec ~ 6.5sec
	Packet mode		(e.g., for 128 octets : Up to 100km ¥0.4 / 1 packet Over 100km ¥0.5 / 1 packet)
	User-to-user signalling		¥0.4/1 message (Max. 128 octets)

Figure 20

INS-Net 1500 Service Charges

Subscription charge (Non-recurring)			¥ 800
Installation charge (Non-recurring)			¥102,000
Monthly charges	Line charge		¥ 31,000
	Equipment connection charge		¥ 2,000
	Equipment rental charge		¥ 12,000
	High-speed comm. mode surcharge		¥ 2,000
	Packet mode surcharge	Per one B channel	¥ 3,500
		Per one D channel	¥ 1,000
	User-to-user signalling		———
Call charges	Telephone mode		Same as for ordinary analog telephone
	Digital mode		① 64kb/s(Charge unit ¥10)180sec ~ 6.5sec ② 384kb/s(Charge unit ¥30) 90sec ~ 6.0sec ③ 1.5Mb/s(Charge unit ¥80) 50sec ~ 4.5sec
	Packet mode		(ex. 128 octets Up to 100km ¥0.4 / 1 packet Over 100km ¥0.5 / 1 packet)
	User-to-user signalling		¥0.4/1 message (Max. 128 octets)

Figure 21

Charges for INS-Net Supplementary Services

Supplementary Service	Monthly Charge
Calling line identification	———
Advice of charge	———
Sub-addressing	———
Terminal portability	———
Flexphone (CW, 3P, CT, CD)	4 available functions : ¥1,000 (¥200 reduction for unneeded function)
Direct dialling in, Free dial, etc.	Same as for analog telephone network

Figure 22

Yet, at present, few terminals are available for ISDN home use. Thus, NTT has been developing the ISDN home use telephone. (Photograph 5)

Schematic Diagram of the Telephone for ISDN *Home Use* (1)

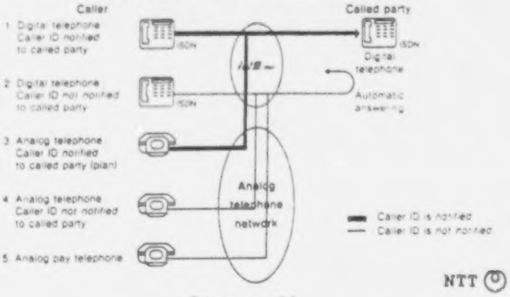

Caller
Called party
1 Digital telephone Caller ID notified to called party
2 Digital telephone Caller ID not notified to called party
3 Analog telephone Caller ID notified to called party (plan)
4 Analog telephone Caller ID not notified to called party
5 Analog pay telephone
ISDN
Digital telephone
Automatic answering
Analog telephone network
Caller ID is notified
Caller ID is not notified

Figure 23

Schematic Diagram of the Telephone for ISDN *Home Use* (2-a)

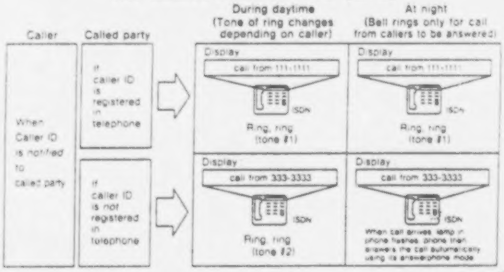

Caller
Called party
During daytime (Tone of ring changes depending on caller)
At night (Bell rings only for call from callers to be answered)
When Caller ID is notified to called party
If caller ID is registered in telephone
If caller ID is not registered in telephone
Display
call from 111-1111
call from 333-3333
ISDN
Ring, ring (tone #1)
Ring, ring (tone #2)
When call arrives, lamp in phone flashes, phone then answers the call automatically using its answerphone mode

Figure 24

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Shematic Diagram of the Telephone for ISDN *Home Use* (2-b)

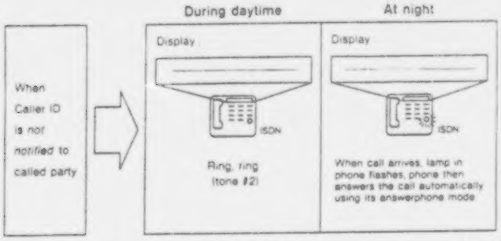

During daytime
At night
When Caller ID is not notified to called party
Display
ISDN
Ring, ring (tone #2)
Display
ISDN
When call arrives, lamp in phone flashes, phone then answers the call automatically using its answerphone mode

Figure 25

The telephone has a function to shut out prank calls. Using the Calling Line Identification function, the telephone makes it possible for the called party to answer calls selectively; wanted calls will be connected while unwanted calls will be automatically answered and then disconnected. (Figure 23,24,25)

8. PROMOTION OF ISDN FOR GLOBAL USE

Much has been said recently about the potential benefits of a global ISDN. Now, INS-Net customers can take advantage of ISDN service between Japan and five other countries, that is, the US, UK, France, Australia, and Singapore. (Figure 26)

Global ISDN

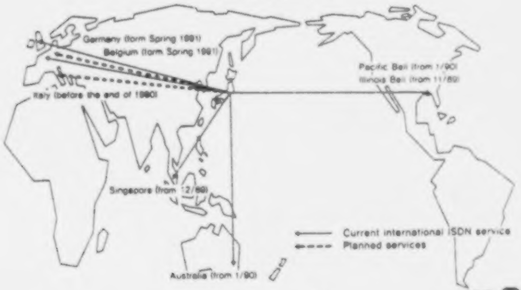

Germany (form Spring 1991)
Belgium (form Spring 1991)
Italy (before the end of 1990)
Pacific Bell (from 1/90)
Illinois Bell (from 11/89)
Singapore (from 12/89)
Australia (from 1/90)
Current international ISDN service
Planned services

Figure 26

In line with this, NTT has been promoting the concept of global ISDNs. Through the ISDN link between NTT's INS-Net and France Telecom's NUMERIS via KDD's ISDN, Canon and Wagons-lits Tourisme began G4 facsimile communication and data transmission respectively in the summer of 1990. Later, Sony and CLI, and Ricoh with Tekelec started to use similar linkups between Japan and the US. Using the ISDN link between NTT's INS-Net and Pacific Bell's Centrex-IS via KDD's and AT&T's ISDN, these companies carry out video conferencing, G4 facsimile communication, and data transmission using work stations respectively. In the near future, INS-Net customers in Japan will be able to use ISDN service with Italy, Germany, and Belgium.

9. FUTURE PROSPECTS OF INS-Net SERVICES

9.1 ISSUES AFFECTING THE GROWTH OF INS-Net SERVICES

NTT aimes to install over 1 million INS-Net lines by 1995. (Figure 27)

Growth of ISDN Subscribers in NTT

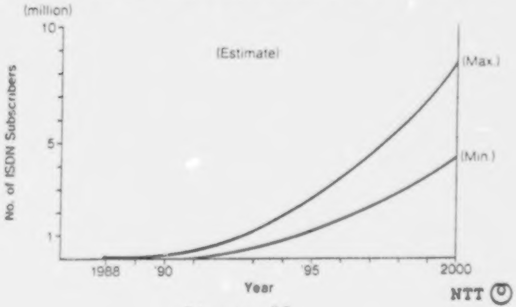


Figure 27

With the continuing growth of available services, along with the determined expansion of service area, this target appears attainable. However, before NTT began its policy of extending INS-Net services to wherever demand existed, service was predominantly limited to metropolitan areas. This limited the customer base, and had the corresponding effect of reducing the motivation among terminal makers to increase productions, and thus bring the price down. (Figure 28)

Vicious Circle in Promoting ISDN

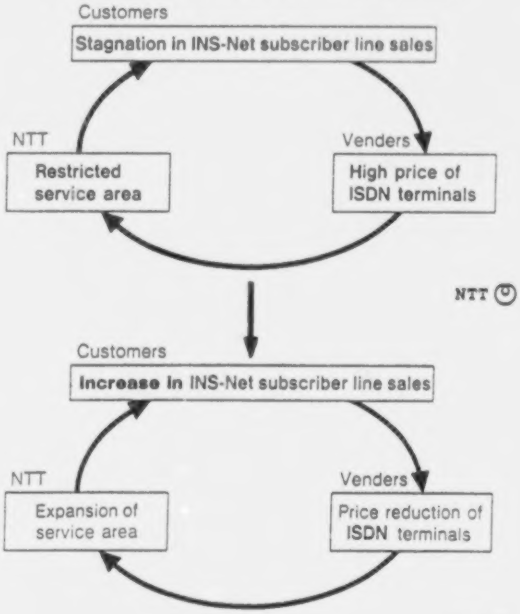
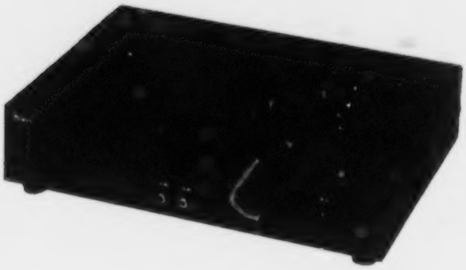
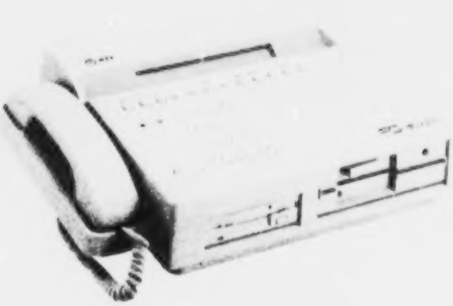

Customers
Stagnation in INS-Net subscriber line sales
NTT
Restricted service area
Venders
High price of ISDN terminals
Customers
Increase in INS-Net subscriber line sales
NTT
Expansion of service area
Venders
Price reduction of ISDN terminals

Figure 28



Photograph 1. 7kHz VOICE CODEC UNIT
(NTT HC-7000)



Photograph 2. FD DATA TRANSFER TERMINAL
(NTT FD TRANSFER)

Photograph 3. ISDN PUBLIC TELEPHONE

Photograph 4. VIDEOPHONE FOR THE VIDEO
AND VOICE MESSAGING SYSTEM

Photograph 5. ISDN HOME USE TELEPHONE
(PROTOTYPE)

Photograph 6. ISDN DIGITAL TELEPHONE
(NTT S-1000)

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The agressive expansion of the INS-Net service area has brought about a significant increase in the number of subscribers. However, terminal prices are still quite high. For example, the average price of G4 facsimiles is about ¥3 million, and about ¥200,000 for digital telephones, which are about 10 times as high as that of analog terminals. Also, the price of video conferencing systems ranges from ¥10 million to ¥20 million. In order to promote the expanded use of INS-Net services, a price reduction for terminals is essential.

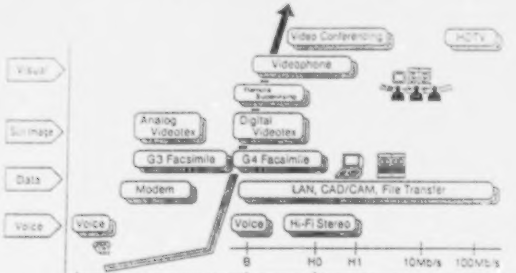
9.2 PRICE REDUCTION OF ISDN TERMINALS

In response to the demand for less costly ISDN terminals, NTT developed and provided customers with a digital telephone, called S-1000 that sells for about ¥30,000. (Photograph 6) With regard to G4 facsimile, NTT projected that it would take a few years before price competition began among G4 facsimile vendors. Recently, however, Canon marketed a low-price G4 facsimile for ¥1.68 million. Although this competition has just begun, NTT forecasts that prices for G4 facsimile will fall faster than they did for the G3 facsimile,and that as prices come down, customers will increase accordingly. As for video terminals, now that the video CODEC has been standardized by CCITT, prices will soon be reduced, and the applications using video terminals will increase.

10. CONCLUSION

NTT has developed ISDN applications aimed at enhancing services for business, public, home, and global use. As INS-Net services become both more convenient and economical, the number of new subscribers continues to grow, surpassing our original projections. Users are also becoming more sophisticated regarding the potential applications of ISDNs. As a result, INS-Net is now gradually taking the place of the conventional telephone network, and becoming the second telecommunication infrastructure in Japan. We hope that the day will come soon when peoples all over the world are connected by ISDN. To further this goal, NTT is now making every effort to promote INS-Net services, and to realize the broadband ISDN. (Figure 29)

Development toward ISDN


Video Conferencing
HDTV
Visual
Videophone
Remote Supervising
Still image
Analog Videotex
Digital Videotex
G3 Facsimile
G4 Facsimile
Data
Modem
LAN, CAD/CAM, File Transfer
Voice
Voice
Voice
Hi-Fi Stereo
B
H0
H1
10Mb/s
100Mb/s
1890
1988
1989
2000
year

NTT

Figure 29

11. REFERENCE: TECHNICAL ASPECTS OF NTT'S ISDN

Features of NTT's ISDN

- TCM (Time Compression Multiplex) digital subscriber transmission system for BRI, using existing copper wires
- Introduction of SM (Single Mode) optical fiber cable for PRI
- Addition of ISDN module or packet module to the existing digital local switch
- Introduction of ISUP as common channel signalling system between central offices

Figure 30

NTT

Block diagram of INS-Net system

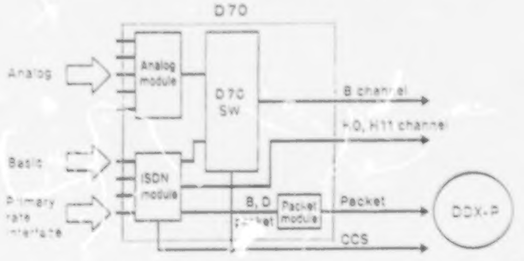

D70
Analog
Analog module
D70 SW
B channel
H0, H11 channel
Basic
ISDN module
Primary rate interface
B, D packet
Packet module
Packet
DDX-P
CCS

Figure 31

NTT

Implementation of CCITT No.7 CCS

TUP (Telephone User Part) was introduced in 1982

ISUP (ISDN User Part) was introduced in 1988

- ISUP is essential to ensuring the transmission of the various information such as B.C (Bearer Capability), Terminal Compatibility check, calling party number, Sub-addressing and User-to-User Signaling

Figure 32

NTT

INFORMATION TECHNOLOGY AND THE TRAVEL INDUSTRY

by

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The travel industry is the world's largest information industry. Given that the same basic transportation, lodging, rental, and leisure services are offered by many entities, service providers in the travel industry must place great emphasis on differentiating their services through information technology. Despite pervasive use of digital networks, market-tailored information services and user interfaces, and increasing use of computer integrated telephony, distributed databases, and other cutting edge telecommunications and computer technologies, literature about the use of information technology in the travel industry is scarce. This paper provides a descriptive overview of information technology and the travel industry and describes one scenario for the introduction of wide area networked interactive multimedia.

I. INTRODUCTION

The travel industry, from the bleary denizens of the red-eyes over continents and oceans to the wave-thrashed, one-week captives of surf and snorkeling, is a vast relational database, a database of thirty million airfares, even more arrival and departure times, millions of room-nights, tens of thousands of rental cars, thousands of carriers. Agents daily clatter on keyboards in response to colored, windowed screens and fickle, small voices muttering in headset earpieces. Unseen are the thousands of disk drives, front end processors, packet switched circuits, and huddled masses of programmers trying to perfect client/server architectures, dynamically assigned bandwidth, and interactive multimedia. The forefront of business information technology is, without doubt, the travel industry. Astronomic permutations of "seats and rooms" overlaid with personal preferences and corporate travel policies all point to information technology as *the* strategic business weapon. The travel industry is understandably the biggest market for computers and telecommunications.

Despite the size and economic clout of the travel industry, there are no magazines, associations, or books that focus on information technology and the travel industry. To assist those curious about the field, this paper will explore airline and non-airline reservation systems, some of the market segmentation, user interface, and computer integrated telephony techniques used by the reservation system providers to obtain differential advantage. The paper concludes with the suggestion that shortages of skilled labor and an increase in computer literacy among the travelers will lead to endusers (e.g., fliers, hotel guests, car renters) doing more of the work of travel and event planning by using wide area networked interactive multimedia.

II. RESERVATION SYSTEMS

The passenger name record, or "PNR", is the key field in the computerized reservation systems ("CRS") operated by various groups of airlines. "Various groups of airlines" is correct, rather than "individual airlines," after a period of intense consolidation and cross-investment among the airline CRS's. For instance, United Airlines owns a fifty percent interest a partnership named Covia, which operates the second largest CRS, Apollo; six other airlines own unequal interests in the remaining fifty percent. Delta Airlines' CRS, called DATAS II, and the CRS of Northwest Airlines and TWA, called PARS, have merged to form the third largest CRS, "Worldspan." The owner of Eastern and Continental operates the fourth largest CRS, "System One." Sabre, the largest CRS, is wholly owned by American Airlines' parent, AMR. Astoundingly, AMR makes more profit from Sabre than from American Airlines. Each transaction on a CRS may yield the CRS operator from US $1.00 to $3.00 of revenue. Outside the U.S., groups of airlines are abandoning their proprietary CRS's to create new CRS's called Amadeus (Europe), Galileo (Europe), Gemini (Canada), and Abacus (Asia).

Joining the PNR in the transaction records of airline CRS's are payment amount and terms, flight numbers, and reservation information for hotel rooms, car rentals, and, increasingly, other types of reservable services associated with an itinerary (e.g., personal computer rentals and day-tours). As explained below, the flexibility and cost of associating additional information and reservable services with the PNR has prompted the creation of competing non-airline CRS's operated by groups of hotels or even computer service bureaux.

The network architecture of CRS's is now undergoing the first major transformation since CRS's began in the 1960's with polled terminals connected to mainframes. The original protocol, a 6-bit enigma called Airline Link Control, is now being replaced by X.25 packet switched links (sometimes consolidated into FT-1, T-1, or E-1 lines) and soon, frame relay. The new European CRS's, especially Amadeus, are driving the creation of European Community-wide private digital (E-1) networks, a first for Europe. Where several user workstations are concentrated, such as in travel agencies and larger corporate travel departments, modern practice is to use local area networks with an X.25 gateway and one or more 56 Kbps links. Most standalone workstations, such as in smaller corporate travel departments and those for individuals, use asynchronous 9.6 Kbps or slower links. X.32 (dial X.25) and switched 56 or 64 Kbps service should soon be adopted by higher volume, standalone CRS workstations.

Despite important developments in online transaction computing (e.g., database hosts with hundreds of microprocessors) and network architectures (e.g., distributed implementations), the principal means of service differentiation among the CRS's are the user interface, segmentation of users, corporate travel policy administration, accounting/reporting, and destination marketing features. As implied above, there are three user segments: travel agent, corporate travel department, and individual. The travel agent (including, for purposes of this discussion, both "independent" and airline reservationists; "independent" is qualified since most service contracts for airline CRS's require a travel agency to use the offered CRS exclusively) and corporate user interfaces are basically the same and receive most of the development attention. Travel agent and corporate user interfaces range from plain vanilla ASCII to Microsoft Windows applications with mouse interfaces and high resolution screens. User interfaces for individuals, such as those offered by EAASY SABRE and OAG, are ASCII based and accessible through GEnie, CompuServe, videotex gateways, and other VANs and service bureaux.

The more easily a CRS feature can be tailored to benefit a travel agency, corporate travel department, or individual, the more attractive the service is to the end-user. The accounting/reporting feature is particularly important to corporate travel departments. Corporations universally desire to cut travel expenses without compromising corporate profitability. Corporations, therefore, try to negotiate favorable corporate rates with airlines, hotels and hotel chains, car rental companies, etc. After rates are negotiated, the corporation's travel policy is revised to require that corporate personnel use the subject airlines, hotels, and rental cars at the negotiated rates. How does the corporation ensure compliance with its corporate travel policy, especially for mid-itinerary changes? How, moreover, does the corporation present to service providers the facts of the corporation's airline, hotel, rental car, etc., usage in its efforts to obtain discounted rates?

Corporations often find that normal accounting data based on travel expense reports and travel agency invoices cannot be sorted to produce, say, room-nights in cities where a particular hotel chain operates hotel properties, or total car rentals, or total flights between given city-pairs, or ammunition for negotiation. The accounting and reporting features of a CRS are therefore intimately related the creation and maintenance of a corporate travel policy and to obtaining discounted rates from service providers.

CRS software with complete interfaces to an agency's or corporate travel department's MIS and financial accounting software is the exception rather than the rule. This is often called the front office (CRS) to back office (financial accounting) connectivity problem. In addition to front office/back office accounting interfaces, reporting, and corporate travel policy administration functions, to remain competitive a CRS must now offer automatic "lowest fare" checking, scripting or macro utilities for agents, wait-list clearing, "group" passenger name record handling (handling a group of related PNR's (e.g., a tour group) as a single entity), electronic commission reporting, and consolidation of booking activity at multiple agency branches (even international) for a single corporate client. Airline CRS's now have significant competition from third party software companies that better interface CRS sales data to MIS and financial accounting systems, provide lowest-fare checking, and the like. Accounting and reporting features are only the beginning, however, of recent changes in, and bases for competition with, airline CRS's.

III. CRS EXTENSIONS AND COMPETITORS

Owners of hotels and car rental companies have long cast eyes of envy toward the profits of airline CRS's and of resentment toward the limited information airline CRS's provide about their hotel properties or other reservable services. To provide more hotel information, and to collect transaction fees, seventeen hotel chains jointly created The Hotel Information Switch Company, or "Thisco". Thisco operates an international CRS, Ultraswitch, which lists and books reservations for the owners' and others' hotel properties on a transaction fee basis. Similarly, AVIS on its WizCom CRS, and GEISCO on its MANOR CRS, now list and book reservations for third party service providers. AVIS' WizCom has interfaces to Sabre, Apollo, Worldspan, and System One; these interfaces enable users of the airline CRS's to book WizCom listed services. In the past year, service providers such as hotel chains and independent hotels, day-tour operators, tour wholesalers, convention bureaus, event promoters, rail and other ground transportation, and cruise lines have begun to list their offerings on these new, non-airline CRS's and, consequently, have been more accessible to reservationists than ever before. The new "alternate CRS's" typically are more flexible in the type and extent of data a service provider can place online. For instance, hotels might list inhouse athletic facilities and restaurants, walking and taxi times to business centers and visitor attractions, or coming special events near the hotel.

The "electronic publishing" of new types of travel information has been most pronounced in "destination marketing." Destination marketing has traditionally been the realm of the glossy brochure. Information technology is rapidly adding new marketing channels to supplement print media. The PARS, now Worldspan, "IRIS" videodisc workstation was the first introduction of "interactive media" to the marketing of travel and accommodations. A standalone workstation designed for use by travel agents, the IRIS workstation is not integrated with a CRS workstation, that is, IRIS workstations require a separate CRT, system unit, and keyboard. Sabre offers the Sabrevision service. Sabrevision has information on 50,000 hotel properties, with data, color still photos, travel maps, and 150 searchable data fields. Unlike IRIS, Sabrevision is integrated with a CRS workstation (running Sabre software, of course) and lacks motion video display.

Covia has plans to release a service, reputedly similar to Sabrevision, called the Apollo Spectrum. Apollo Spectrum will be integrated with the CRS workstation but lack of motion video and audio. The logical extension of these marketing technologies is the inclusion of compressed video and audio (perhaps from a local CD-ROM reader) and the addition of corporate travel departments and individuals as user segments. The growth of destination marketing by interactive multimedia will be an important driver of digital interexchange and local loop traffic.

Electronic mail, including electronic document interchange, is sweeping into all economic sectors and is especially important on national and international markets. Some airline CRS's have begun to provide limited electronic mail services among travel agencies, corporate travel departments, and travelers. After all, an otherwise unreachable traveler must present his or her boarding pass and/or ticket at the gate, and could be handed a hot dispatch from the home office. Most email is more mundane than emergency messages at the gate, but the market potential is clear. Airline CRS's operate highly reliable international communication networks that connect all the places businesspersons go.

A variant of electronic mail is satellite ticket printers. Normally, airline tickets are printed only at airline offices or at travel agencies. A travel agent must apply and be accepted in a "conference" (which in the U.S. is the Airline Reporting Corporation) that issues to the travel agency "plates" that are used to emboss tickets. A travel agency must be bonded and ensure that the travel agency plates and ticket stock are either locked up when not in use or under surveillance when in use. Satellite ticket printers are owned by non-airline networks and located at convenient locations other than travel agencies (e.g., hotels). Satellite ticket printers can be used by travel agencies, corporate travel departments, and airlines. Imagine the convenience of having your travel agency in Sydney print tickets at your Honolulu hotel after a revision of your itinerary. Satellite ticket printer owners represent a new consumer of telecommunications services.

IV. TRAVELER INFORMATION SYSTEMS

Aeronautical to geosynchronous satellite to public switched network voice communication systems are now being deployed in some airliners used for international routes. Airliners on national routes will eventually get satellite phones. The enroute traveler may have to be content with voice, however. There are no publicized plans for onboard fax machines or to put RJ-11 jacks for modems and faxmodems in the onboard handsets. Information technology developments in hotel guest rooms are rosier, however.

The demands of business travelers have persuaded hotel owners to install separate data lines and jacks in guest rooms of new hotels (those demands were expressed both in words and by aggressive use of Swiss army knives and alligator clips as business guests modemed their way onto the public switched network). Some existing hotels are even retrofitting guest rooms with extra data lines and jacks. Rarer though, is a hotel with personal computers to rent, and hotels with in-room videotex terminals or other "information appliances" do not exist (sorry, cable tv doesn't count). The combination of shortages of hotel staff, if not the lure of transaction fees, should induce hotel owners to add information appliances to hotel guest rooms. Room service orders, in-house dining reservations, delivery of phone messages, faxes, telexes, and email, trouble reports, review of conference and convention schedules, and even word processing and other business information processing could all be performed from in-room terminals. The day will come, perhaps not in our lifetimes, when a hotel will permit attractions outside the hotel to be accessible via an in-room information appliance other than the telephone. Another breakthrough will be when a hotel catering to business guests installs an in-house videotex system on selected business floors and puts a laserprinter on each business floor. Every page of printout and every hour and kilobyte of storage will be invoiced and appear on your bill, of course.

V. OPPORTUNITIES

Innovation in network facilities, hardware, and software for travel agencies, hotels, airlines, hotel guests, and corporate travel departments all point toward interactive multimedia. Interactive multimedia, also known as compound documents, is the phrase in favor to describe the ability to display, transmit, store, and even simultaneously share audio, motion video, image, and character information over a network. The last gap in digital connectivity, the local loop, is finally in transition from analog to 56/64 Kbps and ISDN basic rate service. Intermachine (interexchange) trunks have long been digital, as have local area networks and PBXs. Cooperative functionality among on-premises digital devices is growing, e.g., applications on local area networks that provide voice mail or videoconferencing, and telemarketing applications like onscreen records display driven by automatic (calling) number identification. With the addition of digital local loops, these on-premises LAN/PBX systems can be linked by digital wide area networks. Frame relay technologies, with dynamic datarate allocation, will only accelerate wide area networked interactive multimedia applications.

Just as the travel industry is the largest user of information technology, it should be the largest user of wide area networked interactive multimedia applications ("WANIMA"). Destination marketing will probably be the first area of WANIMA development. This effort will build on today's IRIS (videodisc-based) and Sabrevision (videotex-based) products. Probable offerings: the sounds and sights of resorts, meeting and convention facilities, airport layouts, hotel room views, foreign language training, city maps, transit system maps and schedules ... MTV and ETV for travelers, if you will. One organizational result may be associations of travel agencies linked internationally and "on call" through WANIMA to advise travelers or their agents about itineraries. WANIMA could provide information services tailored to both leisure and business travel segments.

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Critics may say that WANIMA will decrease business travel ("why travel if you can videoconference from your desktop?") and won't be supported by the travel industry. The answer, as any conferee knows, is that the most important conference events are conversations in hotel hallways and exhibit areas; and as any businessperson knows, high stakes negotiation, say for a joint venture, is always face-to-face. Desktop videoconferencing should finally give videoconferencing the credibility and mass adoption it has sought for twenty-five years.

The applications of WANIMA are, of course, limited only by imaginations and budgets. The important point here is that airline CRS's already have the electronic and human networks to immediately use WANIMA profitably. Travelers consult with travel agents and corporate travel departments to obtain information, and WANIMA will deliver superior information. The additional cost for a "WANIMA" card in a travel agent's workstation, or in a workstation in the "travel planning cubicle" of a corporation, is insignificant when compared with the information value to be provided. It is probable that after the travel industry has perfected WANIMA technology, the WANIMA floodgates will be opened as educational, general business, and eventually residential/home office sectors adopt the technology. WANIMA, after all, is a pro-environment technology: it enables more efficient travel, better distance education, and eats digital bandwidth like a banshee.

OUTDIAL ACCESS TO THE UNIVERSITY OF HAWAII:
A WESTERN PACIFIC EXPERIENCE

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1. ABSTRACT

This paper describes utilization of outdial technology to access the University of Hawaii Libraries online public access catalogue from remote sites; the library automation, resource sharing and research benefits derived; and the future implications of this capability. Since access depends on using packet-data network technology, the need for continued development of a Pacific regional packet-data network is also addressed.

2. INTRODUCTION

The world is in the midst of an information revolution wherein information is rapidly becoming a commodity. In this revolution, access to databases containing information about information is just as essential as the information itself.

In many libraries, machine readable bibliographic records stored in interactive databases are the key to finding the wealth of information within library collections. Traditionally, these bibliographic records have been stored in card catalogues that must be manually searched. Increasingly, libraries are converting their card catalogues into interactive databases and creating online public access catalogues (OPACS), providing users remote access to these records. This access eliminates the re-creation of already existing bibliographic records used for library automation projects, provides a new tool for researchers, and facilitates interlibrary cooperation and sharing of resources.

Access to the information contained in OPACS is essential for the growth and development of the Pacific Basin, just as it is for the other geographic regions of our planet. Unfortunately, "the remoteness of the region, its small population base, inadequate infrastructure, limited financial and natural resources and limited potential for economic development, and the newly emergent nations' restrictive policies toward non indigenous communications services have restricted the availability and access to information technology and systems for Pacific islanders." (1)

Consequently, the systems, technology, and OPAC and database access that people along the Pacific Rim take for granted are unavailable to people in the Pacific Basin except at exorbitant costs. In an attempt to begin addressing the resolution of this problem, a low cost outdial technology has been developed to link the University of Hawaii Computing Center computer system, wherein the interactive database for the University of Hawaii Libraries Online Public Access Catalog (UH OPAC) resides, to sites in the Pacific Basin.

3. BACKGROUND

Although library automation in the Pacific Basin is in its' infancy, in 1989, both the Micronesian Area Research Center (MARC) at the University of Guam, and the Northern Marianas College (NMC) in Saipan began planning and implementation of online public access catalogs of their respective library collections.

MARC serves as the principal social and natural science research center in Micronesia. The MARC Pacific Collection Library holds the most extensive collection of materials in the Pacific Basin relating to Guam and Micronesia. The library supports researchers, students, governmental agencies, and the general public.

The NMC in Saipan, the capital island of the Commonwealth of the Northern Mariana Islands, provides post-secondary and continuing/adult education programs to residents of the Commonwealth. Its Olympio T. Borja Memorial Library is the primary source of materials for these academic programs as well as serving as the archives of the Commonwealth of the Northern Mariana Islands.

In both these libraries, cost-effective ways to implement their automation projects were sought.

As Patricia Battin, President of the United States Commission on Preservation and Access recently wrote, "The existence of the large centralized databases of bibliographic records of the nation's libraries made possible the cost-effective automations of local library

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operations by eliminating the costly redundance of cataloging each item independently." (2)

It was believed that many of the items held by both the MARC Pacific Collection and the NMC Olympia T. Borja Library were held and already catalogued in machine readable form by the University of Hawaii and could be used in these automation projects. With this in mind, access to the University of Hawaii Libraries Online Public Access Catalog (UH OPAC) was sought.

The UH OPAC is an interactive database of machine readable bibliographic records. The OPAC is the primary source of information about the books, musical scores, audiovisuals, and periodicals in the campus libraries throughout the University system. It also contains the machine-readable bibliographic records describing some materials in the community college libraries in Hawaii as well as shared cataloging records from the Center for Research Libraries in Chicago.

Given this context, PCI Communications, a Guam Corporation and MARC began discussions on utilizing PCI's regional packet data network, PACNET, to develop a low cost link to the UH OPAC.

4. IMPLEMENTATION

In January, 1990, an outdial modem connected to the PACNET network was installed in Honolulu, Hawaii, and programmed to dial the University of Hawaii Computing Center Starmaster Network, the gateway to the UH OPAC. After testing was completed, PCI Communications offered this capability to MARC.

By April, 1990, the Library staff at MARC was trained and began using outdial technology to access the UH OPAC. The technology was then demonstrated to librarians at the Olympio T. Borja Memorial Library at NMC and outdial access was established there as well.

This system is now providing cataloging records to both the MARC and NMC libraries. To access the UH OPAC, the libraries involved pay only the telecommunication charges, saving the cost and effort of duplicate original cataloging.

4.1 EARLIER IMPLEMENTATION EFFORT

It should be noted that this was not the first attempt to provide Pacific Islanders access to the UH OPAC. The 1988 Hawaii State Legislature recognized this need by stating that "for education and development purposes, network connectivity in the Pacific Islands should include access to interactve databases by remote institutions." (3)

Reacting to this mandate, the University of Hawaii in July 1988 initiated a project to provide remote islands with access to the online catalogs of the library collections of both the University of Hawaii and the University of North Texas using the PEACESAT satellite. The remote islands involved in the project included American Samoa, Tonga, and Western Samoa.

Although the technology used in the earlier project is quite different from the one described in this paper, once a user makes the connection to the UH OPAC, searching the OPAC is carried out in the same fashion. (4)

5. TECHNOLOGY

5.1 COMPARISON OF PDN OUTDIAL WITH PSTN DATA CALLS

To facilitate their library automation efforts, MARC desired to connect a microcomputer located on Guam to the UH OPAC through its telephone lines. The utilization of the Public Switched Telephone Network Service (PSTN) was technically feasible. However, the rates charged by the Guam long distance carriers, RCA Globcom and IT&E, of $1.25/minute for daytime usage (with a 3 minute minimum) on direct dialed calls was not a cost effective solution.

An alternative to the PSTN direct dialed data call is the use of a Packet Data Network (PDN) with an outdial service. PCI Communications operates a PDN named PACNET with service in Guam, Hawaii, Saipan and other Pacific locations. A 2400 BPS data call from Guam or Saipan to the Hawaii Public Outdial Service is tariffed at $.17/minute (with a 3 minute minimum). In addition to the substantial cost savings compared to PSTN, PACNET provides network error correction not available with PSTN data calls.

5.2 PACKET DATA NETWORK

A Packet Data Network (PDN) is a network of nodes (computers that switch and route data traffic) and links which interconnect the nodes. Due to the intelligence of the network, data traffic is directed through the best available route with error correction between each node. This method of data communications provides error free data communications to the largest number of users with the fastest possible response time at the lowest possible cost.

5.3 PUBLIC OUTDIAL SERVICE

Public Outdial Service allows computer communications users to utilize PDN's to communicate asynchronously with remote computers not connected to the PDN's. It consists of an asynchronous access modem and an asynchronous outdial modem connected by a PDN.

The service enables a user having a microcomputer and modem to connect to a PACNET access port with a local call. Users are then able to log into the Hawaii outdial modem which places a local call to the University of Hawaii Starmaster Computing Center Network, the gateway to the UH OPAC.

To utilize this technology, a microcomputer, modem and terminal software must be configured to match the requirements of PACNET and the UH OPAC. These requirements are 2400 BPS, 8 data bits, 1 stop bit, no parity with VT-100 emulation.

Once the hardware and communications software is configured, the basic steps to access the University of Hawaii are as follows:

1. CONNECT TO NETWORK

Place a call to the local access number using a computer and modem. When garbled characters, or the prompt:

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Please type your terminal identifier
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appears, type a character signifying the appropriate identifier (either **A** or O).

2. PACNET LOGIN

The access node will then respond with:

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Please log in:
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Log into PACNET with assigned username and password. This will connect to the Hawaii Public Outdial Service.

3. OUTDIAL

When connected to the Public Outdial Service, the outdial prompt:

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$
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will appear. At that prompt, type 9 to command the outdial modem to dial the preprogrammed University of Hawaii Computing Center access number. The Public Outdial Service uses outdial commands to connect to the University of Hawaii Computing Center Starmaster.

When the message:

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ONLINE!
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appears, pressing **[ENTER]** connects the remote computer to the University of Hawaii Computing Center Starmaster and accessing the UH OPAC can begin.

6. BENEFITS

Public access to OPACs provides librarians with a way of sharing bibliographic records, both for use in cataloging their collections and library automation projects, thus eliminating the duplication of effort. For example, recent searching of the UH OPAC for 100 titles of books in Micronesian languages held by MARC resulted in 46 titles found online. (5)

This access also provides users with a significant research tool. A BITNET computer conference on public access computer systems recently discussed the value of accessing OPACS and one contributor felt that "... finding out what has been published is one of the first steps in a research project. No library buys everything so access to OPACS allows one to compile an extensive bibliography quickly... [and] OPAC searches can take place at any hour of the day and from one's home or office. One is not dependent upon the operating hours of a library." (6)

These benefits are especially important for researchers and academic institutions on Pacific Islands. The remoteness of these islands and their lack of fiscal resources make it impossible to duplicate the research holdings of major libraries. Access to OPACS also allows for more effective interlibrary loan and resource sharing by providing users with information about the location of materials. These benefits, made possible by utilizing outdial technology, will begin to help redress the information imbalance experienced by Pacific Islanders.

7. FUTURE DIRECTIONS

Access to the UH OPAC using outdial technology is a major first step in bringing some of the Pacific Islands into the twenty-first century. But, it is only the beginning of the services a regional packet-data network can provide. For instance, in the November, 1990 revision of the **Internet-Accessible Library Catalogs and Databases**, the University of Hawaii OPAC was listed, but is only one of over 100 online public access library catalogues available throughout the world. (7)

The next step must be to expand the regional packet-data network to other Pacific Islands in addition to Guam and Saipan. At the same time, all Pacific Islands must have the capacity to be linked to other Internet accessible OPACS and databases, utilizing appropriate telecommunications technologies.

Only when this is accomplished can the Pacific Basin begin to take its rightful place in the information age.

Footnotes

1. Kelley, Robert F., Eric Fishman and George Boughton, "Interconnecting the Pacific Basin" in P.J. Booth and C.M. McEachern (eds.), **INTER COMM 90** (Vancouver, British Columbia: INTER COMM, 1990) p. 343.

2. Arms, Caroline (ed.), **Campus Strategies for Libraries and Electronic Information**, EDUCOM Strategies Series on Information Technology (Bedford, Mass.: Digital Press, 1990), p. 5.

3. Mukaida, Lori, Gerald Knezek, Peter Scannell, et.al, "Pacific Island Interactive Data Base Network Access: A PEACESAT, PICHTR, University of Hawaii Pilot Project" in L.S. Harms and D.J. Wedemeyer (eds.), **PTC 89 Proceedings** (Honolulu, Hawaii: Pacific Telecommunications Council, 1989) p. 494.

4. Ibid., pp. 494-501

5. The searches were done in preparation for a National Endowment for Humanities grant proposal submitted by the Micronesian Area Research Center.

6. Mabry, Donald J., "Re: RE- Internet access ot OPACS," in **Internet Access to OPACS, Part III**, (BITNET: Public-Access Computer Systems Forum, PACS-L@UHUPVM1.BITNET, April 11, 1990).

7. St. George, Art and Ron Larsen (eds), **Internet-Accessible Library Catalogs and Databases**, a machine readable file named INTERNET LIBRARY residing on LISTSERV@UNMVM.BITNET, (BITNET: LISTSERV@UNVMV.BITNET, Nov. 1990).

The Emergence of Private Satellite Networks in Latin America

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1. Abstract

The last two years have witnessed the birth and growth of private communication networks in Latin America. The general trend toward privatization of telecommunications has brought dramatic improvements in service availability, communications quality and network infrastructure in various Latin American countries, and satellites have been an important factor in these developments. This paper describes some of the major breakthroughs in Latin American satellite networking. The available satellite options are discussed together with some of the basic technical design issues surrounding private networks. Examples of actual networks are described to illustrate the various applications served and the implementations chosen to provide them.

2. MAJOR BREAKTHROUGHS

Private satellite networks in Latin America started in 1987 with the implementation of the first network operating on the Morelos satellite in Mexico. A major breakthrough occurred when the Mexican PTT allowed the private ownership and operation of satellite networks for corporate and institutional communications. Recent developments have resulted in a very widespread use of private satellite networks for corporate, government and educational purposes.

A second major breakthrough occurred in 1988 with the successful deployment of the Panamsat satellite, which is a "separate satellite system" (i.e independent of Intelsat) which provides both domestic and international communications, primarily in the Americas. This international communication medium has allowed various countries to establish private and public communication services previously unavailable.

A third major breakthrough took place early this year in Brazil when the first privately owned satellite network using Brasilsat was inaugurated. The loosening of government restrictions on telecommunications is launching a major explosion in private networking in Brazil.

3. SATELLITE OPTIONS

The satellite options vary from country to country. A brief summary is given here.

3.1 INTELSAT

This alternative is the obvious, conventional option, offered by the PTT. The use of Intelsat for private networks is regulated and in many countries restricted by the PTT. The Intelsat satellite system has the widest coverage of the world. International as well as intra-regional communications are feasible. Intelsat is available for practically every country. The satellite provides zone and hemispheric coverage at C-band (6/4 GHz) throughout Latin America.

3.2 PANAMSAT

This separate satellite system is the first of its kind. Panamsat is an international satellite that is not attached to the Intelsat system. Panamsat was launched in 1988 and has been approved by the local authorities of a large number of Latin American countries. Panamsat has spawned a competitive environment in the international communications market. It provides the equivalent of a domestic satellite to various countries. Panamsat offers a variety of regional beams in Latin America operating at C-band. It offers direct connectivity to the USA and indirect connectivity to Europe.

A list of countries that allow two way digital services on Panamsat is shown on Table 1. Note there are different types of authorizations needed which vary case by case. Separate entries are shown for one-way video service, which is basically allowed in all countries.

Table 1: Countries allowing the Use of Panamsat

Country	Video	Digital
Mexico	yes	no
Guatemala	yes	yes
Honduras	yes	yes
Costa Rica	yes	yes
Panama	yes	yes
Colombia	yes	yes
Venezuela	yes	yes
Ecuador	yes	yes
Perú	yes	yes
Brazil	yes	in process
Bolivia	yes	in process
Chile	yes	yes
Argentina	yes	yes
Uruguay	yes	in process
Paraguay	yes	in process
Guatemala	yes	yes
Perú	yes	in process
Haiti	yes	yes
Trinidad	yes	yes

3.3 DOMESTIC SATELLITES

Two countries in Latin America have a domestic operational satellite system to date: Brazil and Mexico.
Brazil had its first satellites launched in 1985. Up to last year the satellites had been used exclusively by Embratel, the government branch responsible for its operation. The satellites offer 24 C-band transponders each. The satellites have been under-utilized for the past five years. The opening of the Brazilian PTT to the presence of privately-owned satellite networks has created a burgeoning business in satellite networking. Several local companies have entered into technology-transfer agreements and are producing or will in the near future produce locally made satcom systems. Brazil has signed up for the procurement of the second generation Brasilsat system.

Mexico had its satellites launched in 1985. For the first few years of operation the satellite were severely under-utilized. In 1987 the Mexican PTT decided to allow the operation of privately-owned satcom networks. Private networks were assigned to the Ku-band transponders. In mid 1990 the capacity of the Ku-band transponders was declared to be exhausted. This has resulted in the opening of the available C-band transponders for private networking. The satcom business in Mexico has generated an approximate volume of $50M in sales in the last three years. There are an estimated 50 networks operating to date.

The Mexican satellite operating entity (Telecomm) is currently in the process of procuring the second generation satellite system. There is still some speculation as to whether this new satcom system will have Latin-American coverage.

3.4 COMPARISONS

A user with requirements for satellite links within the American continent in a country with no domestic satellite has typically two options to implement these services: via Intelsat or via Panamsat. Some of the issues that affect this decision are:

a) Legal restrictions
b) Earth station sizing and cost
c) Space segment tariffs
d) Implementation time

These parameters vary case by case and need to be evaluated carefully.

Generally speaking, the equipment cost is smaller for a Panamsat implementation than it is for an Intelsat implementation. This cost differential is due to the higher intensity of the Panamsat transponders, the use of linear polarization, and the less imposing and less conservative standards applied to the system design. The deciding factors in the satellite choice may, however, be of regulatory nature and in some cases may favor the Intelsat approach. Intelsat also offers the advantage of multiple satellites which may imply some backup capabilities.

4. TECHNICAL ISSUES

The prospective buyer of a private satellite communications network or service is typically faced with various implementation choices. The following briefly summarizes the types of technologies available and the system design issues surrounding the proper choice of a network architecture.

4.1 VSAT AND NON-VSAT SYSTEMS

The term VSAT strictly stands for very small aperture terminal and it could encompass any earth station with a "small" antenna. More frequently, the term is associated with a system architecture employing TDMA (time-division multiple access) on the inbound channels in a star network. We shall use the latter definition when describing VSAT systems.

Data applications involving low throughput and bursty traffic and a star network topology lend themselves to VSAT applications very naturally. For this type of traffic (average throughput $\leq$ 1kbps) sharing a satellite channel among many earth stations (the TDMA concept) results in a very efficient usage of the satellite resources, i.e. transponder power and bandwidth.

Applications involving medium to high traffic -- be it data and/or voice -- are usually best served with non-VSAT systems, such as conventional FDMA (frequency division multiple access) or full mesh TDMA.

4.2 FREQUENCY BANDS

In some cases, a choice between C-band and Ku-band is available. The most relevant issues around the frequency band selection are:

(i) Ku-band transponders are typically higher-powered than C-band transponders thus providing higher power densities and allowing the use of smaller antennas.

(ii) Ku-band signals, on the other hand, are much more sensitive to rain attenuation, thus requiring the use of power margins to compensate for this effect. The link availability objective (% of uptime) will be a determining factor in the band selection. Availability objectives much higher than 99.9% are best served with C-band systems.

(iii) The C-band has the serious disadvantage of being shared by both satellite and terrestrial applications. Thus, the potential for interference exists; and most importantly, a sometimes complicated clearance process has to be followed before a license is obtained. Ku-band, on the other hand, is exclusively allocated for satellite communications and the licensing process is straightforward.

4.3 NETWORK MANAGEMENT

A critical element of any satellite communication network is the issue of monitoring and control. A properly designed system should include a network management system, be it centralized or distributed; operated by the user or by the service provider. Network management will enhance the system uptime and facilitate network troubleshooting.

5. EXAMPLES OF ACTUAL NETWORKS

A few examples of operating private satellite networks in Latin America are described in the following. The examples chosen have particular relevance since they represent cornerstones in the privatization of telecommunications in Latin America. The institutions listed herein participated in the lengthy process of government licenses, special authorizations, preparation of new rulings, etc. being the first of their kind in their respective countries.

5.1 MEXICO

The first operational private satellite network was implemented by the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), an educational institution with 26 campuses throughout Mexico. This system provides ITESM an integrated voice and data network. The data network is an extended LAN, or wide area network (WAN) based on IEEE802.3 (Ethernet) technology that interconnects all of the campuses and, in addition, has links into other universities in Mexico and the US. The Morelos satellite provides both the domestic and international (Mexico-US) coverage. The network is implemented in a star architecture using FDMA satellite channels.

Another example is the DuPont de Mexico network with 14 nodes in Mexico and the US configured as a hybrid star/mesh network. The US/Mexico link on the Morelos satellite was the first of its kind. Corporate voice and data applications are served in this network. Productivity of the various divisions of DuPont has experienced a dramatic increase due to the newly available communications facilities.

5.2 BRAZIL

Several financial institutions have satellite data networks based on the Brasilsat satellite system. One of them, Banco Bamerindus do Brasil, inaugurated the first privately-owned system this year. The network serves the various branches of the bank and was configured with VSATs in a star topology with the hub station located at the bank's headquarters in Curitiba.

5.3 HONDURAS

The Honduran PTT, Hondutel, is in the process of implementing the first satellite rural telephony network in Central America. The first few nodes of the network have become operational and the full first phase (31 nodes) will be completed early 1991. Hondutel acquired space segment capacity on Panamsat. Their satellite network has a star topology with FDMA links serving voice, data, Fax, and telex applications.

5.4 COLOMBIA

The first private satellite network in Colombia was inaugurated by the newspaper El Tiempo this year. The network, which provides image transmission over the satellite, allows El Tiempo to print the paper in various sites simultaneously. The signal is broadcasted from Bogotá to Barranquilla and Cali with duplex digital control channels to each site. The network uses the North Beam of Panamsat.

5.5 OTHERS

Examples of their institutions with digital private links are:
Citibank in Haiti, Ecuador and Panamá.
Banco del Pacífico in Ecuador
(with links to the US).
Cerro Tololo Observatory in Chile (link to US).

6. FUTURE OUTLOOK

The introduction of these first private networks has spawned a dramatic growth in satellite systems. An enormous interest exists now among corporate, educational, and government institutions in the implementation of similar networks. Many more networks have become operational in the last year serving all types of applications.

The political, economic, and technological conditions of most Latin American countries are currently facilitating an explosive growth in private satellite communications. Participation and regulation by the local PTTs will continue but with much more open policies. The competitive environment in telecommunications is being created with a significant benefit to the end user. Services priorly not available to the user are being offered now and some other services - such as telephony - become expeditiously available to the users. On top of that, communications quality and reliability are being improved.

THE TONGASAT ASIA-PACIFIC REGIONAL COMMUNICATIONS SATELLITE SYSTEM

Dr. Mats C. Nilson, Managing Director, TONGASAT

1.ABSTRACT

"AN INTERCONNECTED WORLD: IMPROVING THE QUALITY OF LIFE FOR ALL"

The Kingdom of Tonga is planning a regional system to serve some 70 jurisdictions in the Asia-Pacific area with over 3 billion population, using small earth stations to provide rural and inter-island links for domestic and international communications. This enables carriers to operate complementary and alternative facilities and to provide direct rural to rural area satellite links, supplementing those of INTELSAT.

2. INTRODUCTION

"AN INTERCONNECTED WORLD: IMPROVING THE QUALITY OF LIFE FOR ALL" is the theme of the next ITU sponsored International Telecommunications Exhibition and Forum, "TELECOM 91", which will take place in Geneva in October. TONGASAT and the Kingdom of Tonga strive to make the implementation of the ASIA-PACIFIC REGIONAL COMMUNICATIONS SATELLITE SYSTEM a center piece of that 1990's theme!

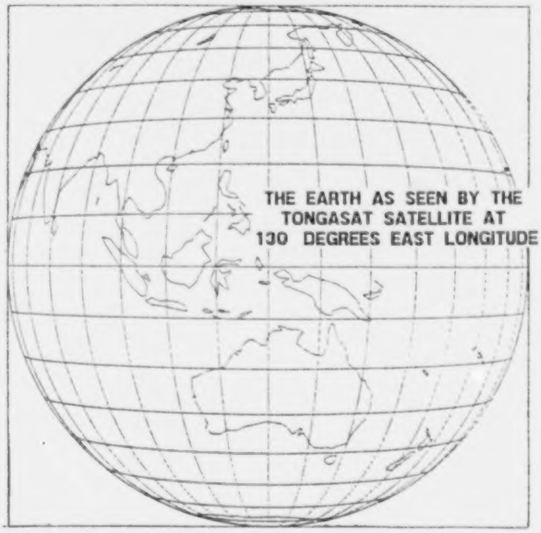
VSAT technology has come into use mainly in North America. The planned TONGASAT regional system relies heavily on introduction and use of VSAT earth stations to accomplish the "improvement of the quality of life for all" in the 70-some jurisdictions reachable by TONGASAT satellites in orbit over the middle of the Asia-Pacific region.

With TONGASAT satellites serving VSAT networks in rural and island communities, nations can stop the current relentless migration into their crowded capital cities. Through the provision of cost-effective and reliable communications, factories and businesses will migrate to the country-side. In so doing they can provide much needed employment there. Likewise, more plantations, farms, fish farms, etc. will be successful in the rural and island areas, due to improved domestic and international communications. All of this will benefit many nations and territories in the Asia-Pacific region, the capital cities of some which tend to otherwise be powerless to stop the inflow of migrants from rural areas looking for employment.

Investments will flow into countries which establish reliable rural and island communications, because industries, government agencies and employers who relocate there can capitalize on the inexpensive, reliable and honest manpower available in those rural communities.

Hence the introduction of TONGASAT's type of cost-effective communications facilities and the concommitant increase in employment will benefit each country through growth of its GNP — especially since the factories and businesses in the country side will be able to communicate internationally as well as domestically, to conduct better negotiations for successful trading.

The TONGASAT regional system will be owned and operated by the Investing Signatories, which may represent their jurisdictions. TONGASAT will be the Signatory of the Kingdom of Tonga and will hold a share of about 10%. Investing Signatories will hold shares in an "International Ownership Body" in proportion to their respective investment. (Ownership shares will not depend on the traffic share or a quota method.) Countries or other jurisdictions may appoint as Signatory either an Investing or non-investing Signatory.



THE EARTH AS SEEN BY THE TONGASAT SATELLITE AT 130 DEGREES EAST LONGITUDE

3. BACKGROUND

FRIENDLY ISLANDS SATELLITE COMMUNICATIONS LIMITED (TONGASAT), a company registered in the Kingdom of Tonga, intends to provide the opportunity for all people in the Asia-Pacific region to have the luxury of services like those described above.

The Kingdom of Tonga in early 1988 licensed TONGASAT to seize the initiative for the benefit of all nations in the Asia-Pacific region, to establish this ambitious satellite system to accomplish linking together the entire region's communications systems. From Hawaii and Tahiti in the East, to India, Pakistan, Iran and the Saudi peninsula in the West. From the USSR and China in the North to New Zealand and Australia in the South. Via direct single satellite hops, WITHOUT LONG AND EXPENSIVE TERRESTRIAL LAND-TAILS.

FEATURES OF TONGASAT

- -- BROAD REGIONAL COVERAGE TO REACH HUGE MARKET AREA
- -- SAME EARTH STATIONS FOR DOMESTIC AND INTERNATIONAL TRAFFIC
- -- BY-PASS TERRESTRIAL NETWORK
- -- INEXPENSIVE SMALL COMMUNITY AND CUSTOMER PREMISE STATIONS (PARKING LOT, ROOF TOP, DRIVE-WAY)
- -- ACCESS FROM RURAL AREAS
- -- INTER-ISLAND COMMUNICATIONS
- -- CULTURAL/EDUCATIONAL TV DISTRIBUTION

The unique services to be offered by the TONGASAT system can commence in 1994 throughout the Asia-Pacific region, provided an adequate number of governmental jurisdictions declare themselves willing to have an entity represent each as a Signatory and be permitted to access the satellites directly from each participating country. Those Signatory entities will be partners in the satellite system. Access should preferable be permitted to come via small earth stations built in each community and in the major cities, at customer premises or at telephone company and other telecommunications carrier swithing centers.

During the last three years, TONGASAT and the Government of the Kingdom have registered with the IFRB in Geneva a set of satellite orbital positions, optimized for the purpose of reaching Hawaii in the East and reaching countries as far West as possible — e.g. Iran, Bangladesh, Yemen, Oman and Somalia — positions that are optimized to provide the highest elevation angles over the ASEAN and East Asian areas. SUCH ORBITAL POSITIONS IN THE ORBITAL ARC OF INTEREST OVER EAST ASIA ARE NOW VERY SCARCE.

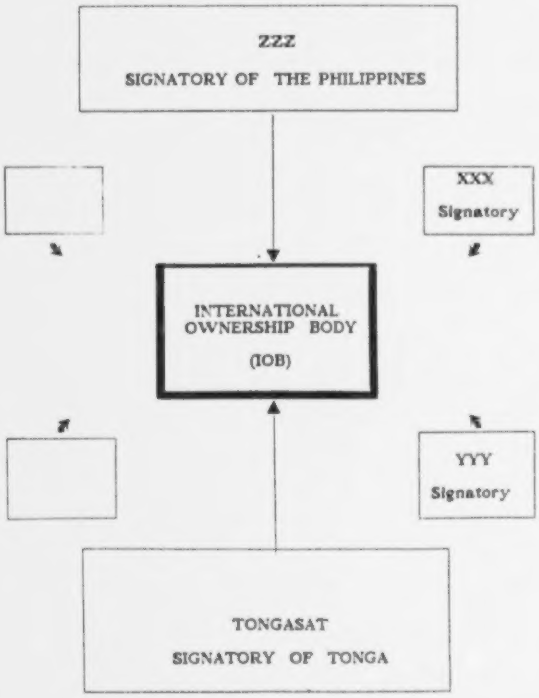
IN THAT PARTICULAR PORTION OF THE ORBITAL ARC, FROM 125 DEGREES EAST TO ABOUT 150 DEGREES EAST, OF MOST VALUE TO A COMMUNICATIONS SATELLITE SYSTEM DESIGNED TO SERVE MOST OF THE ASIAN COUNTRIES, IN ADDITION TO THE PACIFIC AND ASEAN COUNTRIES, AND STILL REACH THE UNITED STATES, TONGA HAS REGISTERED AND THEREFORE CONTROLS SOME OF THE LAST SUCH REMAINING POSITIONS. THUS TONGA POSSESSES THE ASSET MOST CRITICAL TO THE ESTABLISHMENT OF AN ASIA-PACIFIC REGIONAL COMMUNICATIONS SATELLITE SYSTEM — NAMELY THE ORBITAL ARC POSITIONS VITAL TO ECONOMIC SUCCESS.

4. INSTITUTIONAL ARRANGEMENTS

About 70 geographical entities, whether island nations, territories, protectorates or continental countries, all within reach of the regional satellite system, are invited to make the TONGASAT facilities available to users in each of their jurisdictions. The Government of the Kingdom of Tonga is making overtures to the governments of those jurisdictions, inviting them to consider permitting their communications users to participate AND TO DIALOGUE CONCERNING ESTABLISHING A SIGNATORY TO REPRESENT THE USERS IN EACH COUNTRY.

An "INTERNATIONAL OWNERSHIP BODY" will be set up, comprised of "SIGNATORIES" of each jurisdiction. Some of the Signatories will provide the investment funding necessary to launch the initial US$400 - $600 million satellite system. The Investing Signatories will set the tariffs charged to all using Signatories. Non-investing and Investing Signatories will together set policies of the International Ownership Body (IOB).

Investing Signatories will hold ownership shares equivalent to the monetary or in-kind investment value they contribute to the total capitalization required for each successive generation of the TONGASAT regional system. In-kind investment can be in the form of launch services or satellites or TT&C facilities — The Kingdom of Tonga's Signatory, TONGASAT, will contribute the IFRB registered and coordinated satellite orbital positions in lieu of cash. TONGASAT expects to hold about 10% of the initial system equity.



TYPICAL FINANCIERS

- -- **COMMUNICATIONS CARRIERS**
- -- **TELEPHONE COMPANIES**
- -- **TV & RADIO NETWORKS**
- -- **PT & T**
- -- **MULTI-NATIONAL COMPANIES**
- -- **BANKS, FINANCIAL INSTITUTIONS**
- -- **MANUFACTURERS OF SATELLITES, LAUNCH VEHICLES AND EARTH STATIONS**
- -- **TV CABLE NETWORKS**

The IOB participation differs from INTELSAT in that the percentage of capital/ownership need not be in relation to the usage or minimum quota of the particular Signatory of the IOB — in fact, contrary to the institutional requirement of a minimum ownership quota in INTELSAT, Signatories do not need to be Investing Signatories in the TONGASAT IOB owned and operated regional system.

Signatories to the international partnership IOB are expected to be single carriers, such as telephone companies or leased line and data network providers, or groups of communications carriers — or what are called carriers' carriers — or TV networks or cable TV providers, multinational companies or financial institutions or Government PTT's or agencies. In any case, the Signatory of a jurisdiction will need to be licensed or permitted by its Government to provide communications services to and from its territory via the TONGASAT regional system satellites.

In some countries, it is possible that the current INTELSAT Signatory could also become the TONGASAT IOB system Signatory. In others, the latter will be considered competitive to the INTELSAT Signatory, in that the TONGASAT system provides some competitive services on its mainly complementary facilities.

Any jurisdiction can allow its users access to the TONGASAT regional system. Signatories, users, telephone companies, cellular systems or other carriers only need to provide SMALL earth stations and facilities for interconnection to the domestic subscribers. They pay for satellite capacity through the Signatory, whether an Investing Signatory or not. Non-investing Signatories pay nominal additional IOB administrative, technical coordination and billing service charges.

5. IMPLEMENTATION SCHEDULE

TONGA ENVISIONS THE REGIONAL SATELLITE SYSTEM TO BE LAUNCHED DURING 1994 TO 1999, IN ORDER TO COMMENCE SATISFYING THE ENORMOUS INCREASE IN DEMAND FOR COMMUNICATIONS SATELLITE CAPACITY, FORESEEN TO TAKE PLACE DURING THE LATTER HALF OF THE 1990'S, FOR BOTH DOMESTIC AND INTERNATIONAL TELECOMMUNICATIONS LINKS IN THE ASIA-PACIFIC REGION.

DOMESTIC USE CAN START EARLIER, PERHAPS BY TONGASAT LAUNCHING ONE SATELLITE ON BEHALF OF COUNTRIES NEEDING DOMESTIC COMMUNICATIONS BY 1993 OR 1994.

CONSTRUCTION OF THE SATELLITES WILL NEED TO BEGIN APPROXIMATELY TWO TO TWO AND ONE HALF YEARS BEFORE THE FIRST LAUNCH IS REQUIRED. IF SATELLITES THAT ARE ALREADY UNDER PRODUCTION FOR ANOTHER CUSTOMER CAN BE PURCHASED FOR THE TONGASAT REGIONAL SYSTEM, THEN DELIVERY TIME CAN BE SUBSTANTIALLY REDUCED.

THEREFORE, THE INITIAL REGIONAL SYSTEM "INTERNATIONAL OWNERSHIP BODY" (IOB) SHOULD PREFERABLY FORMULATE ITS REQUIREMENTS DURING LATE 1991 AND EARLY 1992, SO THAT SATELLITE AND LAUNCH VEHICLE SPECIFICATIONS CAN BE ISSUED BY TONGASAT DURING 1992. IT IS ANTICIPATED THAT SATELLITE AND LAUNCH SERVICES SPECIFICATIONS FOR COUNTRIES WISHING TO COMMENCE WITH A LESS AMBITIOUS DOMESTIC SYSTEM, PERHAPS WITH Ku-BAND TRANSPONDER CAPACITY, COULD BE RELEASED DURING LATE 1991.

6. ASIA-PACIFIC IS A DEPRIVED REGION

Consider the potential benefits to countries in the Asia-Pacific region of a satellite system providing complementary services and alternative communications facilities to those of INTELSAT, like those enjoyed by people in Europe, in the Arab League nations, in ASEAN countries, by USSR INTERSPUTNIK users and by PANAMSAT users.

Additional regional systems will operate over the Atlantic Ocean area, providing services to Europe, South and North America and yet other regional systems are planned for Africa and South America. The Asia-Pacific region is the only major region still in need of a true region-wide VSAT network.

Consider the basics — alternative and competitive communications facilities are very much in vogue throughout the world. The VSAT movement started in the United States, spread to some countries in Europe, then to Japan, all of which permit telecommunications carriers to compete today. Most countries did not permit competition as little as ten years ago, at least not in international link services. Many use VSAT earth stations to accomplish cost-effective links, particularly if islands, mountains, rural points and large territories are to be connected, like in Australia.

"VSATs have the potential to cause a revolution in communications by bringing satellite links direct into business premises" writes the London FINANCIAL (*) TIMES in its 17 July 1990 issue. That article points out that out of some 22,000 VSAT terminals installed world wide by mid-1990 only 200 are in Asia-Pacific. **Out of a total of 70,000 ordered, only some 2,900 will be installed in the Asia-Pacific area!** (Probably mainly in Japan and

Australia, for use with the Ku-band domestic systems there.)

Of course few VSATs are being installed, since there is no satellite system optimized for true VSAT operations yet serving the entire Asia-Pacific area! Since VSAT systems that can be used for **international as well as domestic links** will be of most value to the users, and since most users in the Asia-Pacific region will need interconnection to North America, **TONGASAT'S regional satellites, combined with their optimum orbital positions, are the answer in the Asia-Pacific area.**

The TONGASAT Asia-Pacific regional system will result in benefits to business, trade, industry and tourism in all participating territories.

The services which TONGASAT, together with all the other Signatories of participant territories or nations, will provide on.the Asia-Pacific regional system are not intended to take traffic away from INTELSAT or other satellite systems — the rural and inter-island links that will be established using small inexpensive earth stations cannot cost-effectively be accommodated on the types of satellites employed by INTELSAT in the region today. In some Asia-Pacific countries, no facilities can carry high speed data or other business communications services to and from outlying areas today. Therefore, such traffic will be additional to that already provided by INTELSAT.

The increase in communications traffic will be attributable partly to the growth of business activities in rural and island areas, trading domestically or internationally. In turn, that growth of business activity will be due to the availability of reliable communications, etc.

The same small earth stations established by owner/users or carriers for domestic or rural or inter-island traffic can also be used, via the TONGASAT regional system satellites, to carry circuits to similar small earth stations in other countries. Thus all of a sudden there will also be incremental international traffic, not necessarily competitive to INTELSAT. Some minor amount of that international traffic will be removed from INTELSAT, since the users will find it less expensive to use the regional system, because they will not be paying for long-distance charges to bring the circuit from a rural point to the metropolis, where the INTELSAT earth stations are normally located (or from an INTELSAT earth station to a rural point in the recipient's country, or both). Such long back-hauls normally are expensive and in many cases of low quality. Furthermore, in rural areas there sometimes are no back-haul facilities, or at best unreliable radio systems, available.

Countries that have adopted or permitted competition in telecommunications have seen their users benefit. It is therefore logical that the nations of the Asia-Pacific region will look upon the establishment of the TONGASAT ASIA-PACIFIC REGIONAL COMMUNICATIONS SATELLITE SYSTEM as an excellent opportunity to improve many things in their territories. In fact, many are expected to use the TONGASAT system for domestic links, particularly for rural and inter-island communications and TV distribution, services frequently needed, for instance in the Philippines and Tonga.

-- TRADE IS GROWING

-- INTRA ASIA-PACIFIC NEED FOR TELECOMMUNICATIONS IS INCREASING

-- NEED FOR RURAL AREA COMMUNICATIONS IS URGENT

-- NO EXISTING SYSTEM CAPABLE OF PROVIDING LOW COST COMMUNICATIONS USING SMALL, INEXPENSIVE EARTH STATIONS

-- ECONOMIC GROWTH OF REGION IS DEPENDENT ON IMPROVED COMMUNICATIONS

7. ECONOMICS AND BENEFITS

7.1 BENEFITS TO USERS AND SUBSCRIBERS

"An investigation by the Financial Times earlier [in 1990] showed that international calls are being priced at an average of three times their costs, with the result that consumers world wide are being overcharged more than US$10 Billion a year", continues the 17 July 1990 issue of the Financial Times. "... Europe's phone companies were pricing international private circuits at between four and 20 times cost." — In Asia-Pacific there is a general lack of competition, particularly since there is no region-wide system that can provide links by-passing the telephone companies or the PTT's and the INTELSAT system.

It is evident from experience in North America and Europe that VSAT commercial leased line systems are usually more cost-effective than offerings by telephone companies/PTT's or other state owned carriers, particularly for data communications and for point-to-multipoint distribution services.

Provision of Public Switched Network (PSN) traffic in the Asia-Pacific region would benefit business and the public immensely, particularly in international and rural and inter-island cases. With at best poor telephone networks in sparsely populated and island territories, VSAT is the only cost-effective and rapid solution — even the smallest telephone companies, or new cellular or radio telephone systems and data carriers, can be linked together and provide international and domestic services using the TONGASAT regional system.

Cost savings will benefit rural and island subscribers of all services, including telephone, data and FAX. One-way distribution services, such as financial and news wires, TV, weather services, public service announcements and educational services are cheaper because they go direct to the subscibers. Two-way users will find it less expensive to use the TONGASAT Asia-Pacific regional system, because they will not be paying for long-distance charges to bring the circuit from a rural point or from an island to the metropolis, where the INTELSAT earth stations are normally located (or from an INTELSAT earth station to a rural point in the recipient's country, or both). Such long back-hauls normally are expensive and in many cases of low quality. In addition, in some rural areas of many countries in the Asia-Pacific region, there are at best poor, or no back-haul facilities at all.

TV and radio distribution into small, affordable TVRO's, whether for educational, news, cultural or entertainment purposes, stand to provide benefits to the populations of all nations in the Asia-Pacific region. Even if the well-to-do in most of the capital cities in the Asia-Pacific region today can watch CNN, NHK or other TV programming, in addition to their local or national fare, nothing is available to, perhaps, 90% or more of the population. The TONGASAT regional system will provide TV and radio signals into dishes as small as the 60-120 cm diameter, like the European, North American, Japanese and Australian ones using Ku-band, and into smaller diameter than the North American 6 ft - 12 ft diameter C-band dishes — throughout the Asia-Pacific region — which means that the people of various nations can tune into programs of immense educational value, in terms of exposure to other societies and in terms of building a more understanding world.

Giant "cable systems" with three billion potential subscribers could take advantage of the large coverage area and the ability to distribute TV into small TVRO's, perhaps on a scrambled basis.

There may be no economic yardstick for the benefits to nations IN THE ASIA-PACIFIC REGION of the TV and radio distribution possibilities — but we all know that this is definitely part of the ITU TELECOM 91 Theme "AN INTERCONNECTED WORLD: IMPROVING THE QUALITY OF LIFE FOR ALL".

7.2 BENEFITS TO IOB SYSTEM OWNERS/SIGNATORIES

The Investing Signatories will own 100% of the IOB. The tariffs to customers (themselves plus non-investing Signatories) will be set so that the Investing Signatories will derive an attractive return on investment (ROI), for providing the initial capitalization of US$400 - $600 million. (Just like is done within INTELSAT, where the signatories set the ROI to themselves.) TONGASAT expects no difficulty in achieving an ROI of 14% - 22% per annum as the regional system matures

In addition, Signatories will derive substantial **income from the resale of satellite capacity to carriers or users in their own jurisdictions** (just like INTELSAT signatories, but hopefully not with as large mark-ups as some INTELSAT signatories charge carriers and users in their respective countries).

Non-Investing Signatories will of course derive the same substantial income from the resale of satellite capacity within their own jurisdictions as will the Investing Signatories, but will not enjoy an ROI. Should they later choose to become Investing Signatories, they would then need make a capital contribution commensurate to the then net value of the TONGASAT regional system plus any deficiency in ROI to prior Investing Signatories, based on agreed percentages of shares they would like of the IOB system.

7.3 BENEFITS TO USERS/CARRIERS

Current users will benefit as discussed above, by obtaining more reliable links and links that may by-pass long land line interconnection facilities, resulting in lower subscriber charges. Of course, future users will benefit by having service, as opposed to having had no service at all provided to them in the past — which is the case in rural areas and island communities of a number of the countries to be served by the TONGASAT system.

Individual carriers or groups of Carriers and Carriers' Carriers will generally either be the IOB Signatory of a country or a middle-man. The major long distance telephone company may in some jurisdictions have the greatest incentive to become the IOB Signatory — enabling it to provide better domestic rural and inter-island services, plus less expensive direct connections to cities and outlying areas in other countries, plus path diversity to international destinations.

Phone companies, data carriers and value added networks (VANS) and other network providers derive benefits from having access to alternate facilities — the most outstanding example of which are the alternate facility usages of capacity on trans-ocean cables and INTELSAT satellites — including "cable restoration". Thus carriers will generally benefit from participating in the TONGASAT regional system, since they can offer their subscribers utmost reliability in alternate paths.

It is of course up to the proper authorities in each country to regulate end-user charges. Mark-ups are paid by users to carriers, by carriers to carriers' carriers, and by the latter to the Signatory. That is why Tonga would like to encourage each country to establish an organization as a Signatory to serve the users directly without middle-men, to the extent possible, preferably by letting the users have direct access to the satellites, using their own earth stations. — As for example, telephone companies, small carriers or large industrial and government users.

7.4 IOB SATELLITE SYSTEM ECONOMICS

Probable scenarios of capacity demand, IOB tariffs to Signatories and costs of the first generation of satellites, indicate that an attractive return awaits the initial investing Signatories. When the TONGASAT satellite system reaches maturity, with 4 to 6 operational satellites, the returns on investment (ROI) parallel those of INTELSAT. The ROI will normally exceed 14% after providing for the repayment of the invested capital.

Even before the point is reached, at which the IOB can decide to procure a third or a fourth satellite, as capacity demand fills up the initial two or three satellites, it is expected that tariffs charged can be lowered to benefit the end users, and thereby increase demand for more capacity.

Since most end-users will not be saddled with extra charges for land-tails, the end-user charges are expected to look quite attractive.

Studies by TONGASAT, supported by spacecraft and launch services and insurance costs, bear out that an initial system of two or three C-band satellites will break even at about 40% average over 10 year life capacity loading, at an average revenue to the IOB of US$1.5 Million per year per C-band transponder in 1990 dollars. (I.e., the initial TONGASAT regional system breaks even at a 40% load factor after provision for the repayment of capital, which allows the Investing Signatories to recoup the original total system investment from revenues, to be used toward financing the second generation).

Illustrated here is the IOB ROI % versus the total initial system investment in US$ Millions for a 3-satellite C-band system. This clearly shows that there is ample profit for the IOB Signatories after contributing from revenues 6% to 7% per annum of the total investment toward repayment of capital. With a 75% average load factor over the 10 year life, the IOB ROI lies in the 14% to 17% range, on the conservative assumption of an average revenue of $1.5 Million per year per C-band transponder (range depending on acquisition cost).

Please remember that for Investing Signatories substantial revenues accrue also from re-sale of satellite transponder capacity to users or carrier customers within their respective jurisdictions, thus creating attractive returns on investments into earth stations and interconnect equipment.

With reference to the above conservative scenario, it should be noted that the average revenue per transponder to the IOB is likely to exceed US$1.5 Million per year. This is due to:

- Lease of partial transponders results in higher aggregate average revenues per transponder, which is likely with many smaller participants

- TONGASAT regional system transponders will be higher in power flux density than similar offerors - enabling access by less expensive earth stations

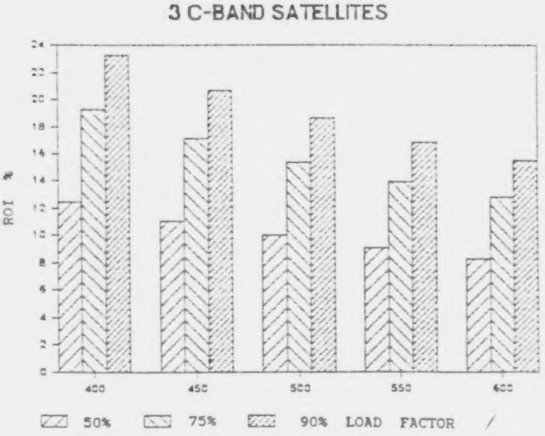
- TONGASAT transponders will be leased on fully or semi-protected bases

If the initial system is a hybrid system (to be determined by the IOB Investing Signatories), then the IOB returns are more attractive.

8. WHY IS TONGA PROMOTING AN ASIA-PACIFIC REGIONAL SYSTEM?

Tonga is a sovereign nation, a member of the ITU and the IFRB and as such enjoys the right to register satellite orbital positions under the terms of the Radio Regulations of the IFRB. Any nation could have seized the same initiative.

The Kingdom of Tonga is well aware that to attain the necessary economy of scale, many nations must together use and finance such an ambitious regional system. To attract participants, Tonga feels that all nations should be invited to own part of the system and that the system must be beneficial to all participants. Tonga and TONGASAT believe that many jurisdictions in the Asia-Pacific area agree that a new satellite system, providing services of a complementary nature and providing alternate path communications facilities will be of value and benefit to the population of each participating nation. Tonga's original objectives are well described by the theme of this year's ITU TELECOM 91, "AN INTERCONNECTED WORLD: IMPROVING THE QUALITY OF LIFE FOR ALL".



ANNUAL R O I VS. TOTAL INVESTMENT IN US$ MILLIONS

FOR LOAD FACTORS OF 50% 75% AND 90%

In addition to the benefit to a nation mentioned above through the provision of VSAT networks, which allow stopping the undesirable migration of labor from the rural areas or islands to the capital city in search of employment, there are several other REASONS FOR PROMOTING AN ASIA-PACIFIC REGIONAL SATELLITE SYSTEM:

—ONE OF THE FOREMOST IS THAT MANY NATIONS IN THE COVERAGE AREA HAVE REQUIREMENTS FOR RURAL OR INTER-ISLAND TELECOMMUNICATIONS LINKS THAT CANNOT ECONOMICALLY AND EASILY BE IMPLEMENTED WITHOUT POWERFUL COMMUNICATIONS SATELLITES, WHICH PERMIT SMALL AND INEXPENSIVE EARTH STATIONS TO BE USED, EITHER FOR DOMESTIC OR FOR INTERNATIONAL COMMUNICATIONS PURPOSES.

—MOST POWERFUL OF ALL REASONS IS PERHAPS THAT A UNITED APPROACH OF SEVERAL COUNTRIES WILL TAKE ADVANTAGE OF THE ECONOMY OF SCALE SO NECESSARY TO MAKE VIABLE A COMMUNICATIONS SYSTEM COSTING HUNDREDS OF MILLIONS OF US DOLLARS.

—AN IMPORTANT REASON IS THAT IT IS BENEFICIAL TO MOST COUNTRIES TO PROVIDE FOR THEIR END-USERS AND COMMUNICATIONS CARRIERS ALTERNATIVE TELECOMMUNICATIONS FACILITIES, ESPECIALLY FOR INTERNATIONAL LINKS. (E. G. MILITARY USERS.)

—NOT LEAST IS THE REASON THAT INTELSAT, WHICH ADMIRABLY PROVIDES SERVICE TO MOST OF THE WORLD'S NATIONS, PERHAPS CANNOT PROVIDE ENOUGH SATELLITE CAPACITY TO SERVE THE GROWING NEEDS OF THE ASIA-PACIFIC REGION IN THE LATE 1990'S, PARTICULARLY NOT TO THE COMMERCIAL AND GOVERNMENTAL/MILITARY USERS IN EACH COUNTRY THROUGHOUT THE ASIA-PACIFIC REGION, WHO WISH TO EMPLOY THEIR OWN SMALLER CUSTOMER PREMISE OR COMMUNITY EARTH STATIONS. THIS IS BECAUSE INTELSAT SATELLITES WERE NOT OPTIMIZED FOR, AND ARE THEREFORE NOT ECONOMICAL FOR, USE WITH SUCH SMALL EARTH STATIONS.

—THERE IS AMPLE DEMAND TO WARRANT A SECOND

SATELLITE NETWORK SERVING THE ENTIRE ASIA-PACIFIC REGION COMMENCING IN THE MID-1990'S, PROVIDING DOMESTIC AND INTERNATIONAL LINKS.

—THERE IS NEED FOR ADDITIONAL CAPABILITY TO REACH OUTLYING OR RURAL AREAS WITH CULTURAL AND EDUCATIONAL TELEVISION AND RADIO PROGRAMMING, USING SMALL, INEXPENSIVE RECEIVE EARTH STATIONS.

—FINALLY, THE ECONOMIC ADVANTAGE OF ELIMINATING IN MOST INSTANCES EXPENSIVE LAND-LINE CONNECTIONS TO REACH DISTANT EARTH STATIONS IS VERY IMPORTANT TO END-USERS IN MOST COUNTRIES IN THE ASIA-PACIFIC REGION.

9. TONGASAT SATELLITE ORBITAL POSITIONS

As discussed, the optimum orbital positions for an Asia-Pacific regional system are those that reach as far West as possible, while still reaching Hawaii in the East. Positions at approximately 125 degrees East longitude and further East reach Hawaii. Positions further East than 125 degrees result in greater elevation angles in Hawaii. In order to achieve reliable service in and out of Hawaii, the TONGASAT satellite must have a minimum reasonable angle of elevation as seen from the earth station located there. That is accomplished by a satellite orbital position no further West in orbit than approximately 125 degrees East longitude. This is important, since the participating Hawaiian earth station will interconnect all TONGASAT ASIA-PACIFIC REGIONAL traffic to the North American terrestrial networks and to satellite systems serving North and South America.

TONGASAT orbital positions registered with the IFRB in this arc segment are as follows:

-	C-band	151.0 E		
-	C-band	148.0 E	C/Ku HYBRID	147.5 E
-	C-band	142.5 E	C/Ku HYBRID	142.5 E
-	C-band	138.0 E	C/Ku HYBRID	138.0 E
-	C-band	134.0 E	C/Ku HYBRID	134.0 E
-	C-band	130/131 E	C/Ku HYBRID	130.0 E

Unfortunately no orbital positions are available in the arc from 125 to 128 degrees East, next to the 130/131 degrees East of TONGASAT. Those orbital positions are taken by Japan/Ku-band at 124 and 128 degrees, PRC/C-band at 125 degrees, USSR/C-band at 128 degrees. Since TONGASAT strives for participation by all geographical territories visible from each satellite position, and since the TONGASAT satellites will have high EIRP and flux densities, it would be virtually impossible to coordinate new positions for TONGASAT in that arc, without excluding the coverage of the respective Japanese, USSR and PRC satellites.

On the West edge of coverage, TONGASAT's more westerly orbital positions reach as far as part of the Arabian Peninsula, at low elevation angles.

TONGASAT

- **HIGH ELEVATION ANGLES IN ASIA**
- **BROADEST GEOGRAPHICAL COVERAGE**
- **C-BAND FOR RAINY CLIMATES**
- **KU-BAND FOR SOME DOMESTIC USE**
- **HIGH POWER TO USE SMALL EARTH STATIONS**
- **ACCESS TO NORTH AMERICA VIA HAWAII**

The most ideal (high) elevation angles are in a longitude band including Taiwan, Korea, Hong Kong, Japan, the ASEAN countries, Australia, New Zealand, Papua New Guinea, Burma, Laos, Vietnam, Cambodia, eastern China and eastern USSR.

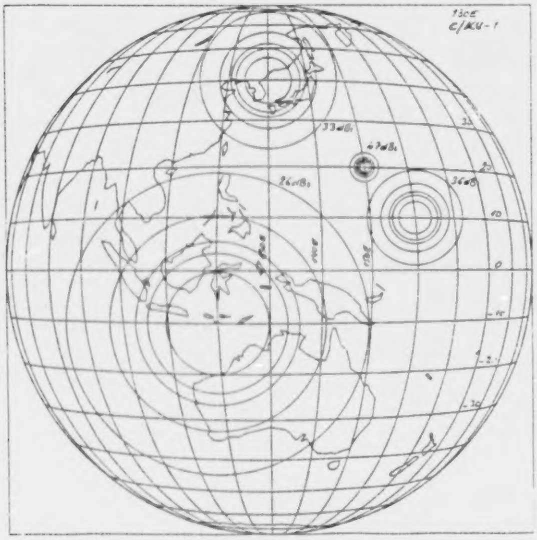
Medium elevation angles are achieved in India, Bangladesh, Sri Lanka, Nepal, Bhutan and in the western China and middle USSR region.

Thus an immense and vast area encompassing nearly 70 geographical jurisdictions, with more than two thirds of the world's population, is reachable by direct single-hop satellite links on the TONGASAT regional system. Neighboring nations near the West edge of coverage, in the Middle East, are able to connect via relatively short land-line links to the TONGASAT regional system, to interface with this vast market area via VSAT's.

Orbital positions must be coordinated with nations holding positions in close longitudinal proximity. TONGASAT satellites, due to high flux density down links and highly sensitive satellite antenna gains for up-linking from small earth stations, make it difficult to coordinate successfully. Furthermore the TONGASAT feature of "global" coverage as seen from each satellite, in order to cover as many geographic jurisdictions as possible, demands that no territory be excluded. If countries with conflicting satellite coverages could be excluded, the coordination would be far less difficult.

TONGASAT has registered additional satellite orbital positions with the IFRB, to guard against the failure of coordination of the above listed 6 orbital positions. Among these are some Ku-band only positions, located further West than 125 degrees East longitude — optimum for the provision of Asia-Pacific regional VSAT services reaching Eastern Europe and the Middle East. They are particularly suited for the provision of true VSAT domestic systems in Asian and ASEAN countries, by virtue of the very high elevation angles, using two-way Ku-band VSAT dishes with 90 cm to 180 cm diameter and TVRO's as small as 60 cm diameter. Other C-band orbital positions were registered by Tonga further East in the equatorial orbit.

THE EARTH AS SEEN BY THE TONGASAT SATELLITE AT 130° EAST LONGITUDE



10. TONGASAT SATELLITE CHARACTERISTICS

The INTERNATIONAL OWNERSHIP BODY (IOB) will decide whether the regional satellites will be C-band or hybrid C- and Ku-band configurations or a mix.

The TONGASAT C-band satellite orbital registrations are for the same transponder and frequency configuration as, and totally compatible with, the US domestic C-band satellites in operation. This configuration was selected by TONGASAT so that a rapid procurement of satellites already in the production line for a US domestic customer could be effected, and so that all earth station electronics and other hardware are completely compatible with the majority of that installed already, both of which factors may contribute to making the TONGASAT regional system more cost-effective.

TONGASAT's frequency plan was selected before that of AsiaSat — which is also totally compatible.

The reason that the TONGASAT regional system can be considered a VSAT system in C-band is that the TONGASAT C-band EIRP levels will be higher than the EIRP levels of US domestic systems and of the Indonesian PALAPA and of AsiaSat. Each satellite will have a feed horn array that enables steerable spot, regional, zonal and hemispheric beams. The narrower coverage, high power beams with C-band transmit antenna gains up to Gmax = 36 dBi will be tailored in each satellite to provide the high EIRP optimized domestic services each partipating territory needs. Satellite receive antenna gains are higher than the typical US domestic systems, to enable small earth stations to up-link.

Each TONGASAT hybrid satellite will carry 12 Ku-band transponders, each of 72 MHz bandwidth, in addition to the same 24 C-band transponders as each of the C-band satellites is equipped, with 36 MHz bandwidth. Smaller satellites with less capacity may be launched to provide an initial domestic services system. Ku-band spacecraft antenna farm gains of up to Gmax = 47 dBi may be provided, particularly for domestic purposes.

The IFRB registrations of TONGASAT orbital positions all permit the highest levels of flux density allowable in accordance with the Radio Regulations (RR). In addition, the uplink powers and satellite receive antenna gains assure true direct VSAT operation without "hubbing" (double-hopping) remote station to remote station traffic through a central hub station. Each TONGASAT orbital location has been registered so as to be able to provide coverage to all geographical territories that can be "seen" from that orbit position.

Typical sizes of coverage areas are illustrated here, for satellite beams with antenna gains of 26, 33, 36 and 47 dBi, at 130 degrees East. All gain contour beams are steerable over the entire globe, as seen from each TONGASAT satellite, in order to optimize and tailor the coverage for each participant nation to meet its needs. The five contours shown are -2, -4, -6, -10 and -20 dB below Gmax. Combinations of feed horns are used to shape regional, zonal or hemispheric beams.

11. CONCLUSIONS

THE TONGASAT ASIA-PACIFIC REGIONAL COMMUNICATIONS SATELLITE SYSTEM

- Is intended to benefit all users, nations and territories in the Asia-Pacific region
- Will be owned and operated by Investing Signatories, as opposed to a dominant investor/owner
- Will not be dominated by the Kingdom of Tonga
- Will reach some 70 geographical jurisdictions
- Will provide services not currently provided by INTELSAT
- Will link together rural and island areas
- Will provide TV distribution into VSAT dishes
- Can provide either Ku- or C-band or both
- Cannot and will not supplant current INTELSAT international services
- Can provide VSAT services on an international basis
- Provides for direct user access, bypassing terrestrial links, even for international links
- Can serve over three billion people
- Will provide domestic and international links
- Will provide alternative and complementary facilities to cable and other satellite systems
- Can interconnect village type cellular systems
- Seeks participation by non-investing entities, as well as Investing Signatories
- Can bypass terrestrial land-tails to reduce subscriber and other end-user charges
- Can provide true VSAT single-hop links, as opposed to "hubbing"

(*) "Why the Open Skies Stay Closed"
FINANCIAL TIMES, Tuesday 17 July 1990

TONGASAT

LEGAL/REGULATORY ASPECTS

- TONGA HAS RIGHT TO USE EACH SATELLITE POSITION PROVIDED SATELLITE LAUNCHED BY 1999 INTO EACH POSITION
- IN ACCORDANCE WITH RADIO REGULATIONS, ALL LEGAL MATTERS FINISHED, EXCEPT FOR TECHNICAL COORDINATION WITH OTHER COUNTRIES
- COORDINATION WITH INTELSAT RE ECONOMIC HARM WILL TAKE PLACE AFTER IOB ESTABLISHED IN LATE 1991
- EACH COUNTRY MAY PERMIT CARRIER ACCESS OR APPOINT SIGNATORY (EXCLUSIVE)
- NO FCC INVOLVEMENT, EXCEPT IN USA

IOB = INTERNATIONAL OWNERSHIP BODY

IMPLEMENTATION SCHEDULE

1987 - 1990 – REGISTRATION OF SATELLITE POSITIONS WITH IFRB

1990 – TONGASAT COMPLETES REGISTRATION OF ALL SATELLITE POSITIONS AND COMMENCES COORDINATION PROCEDURES WITH OTHER COUNTRIES

1990 - 1991 – COUNTRIES INVITED TO INVEST AND/OR APPOINT SIGNATORIES

LATE 1991 - 1992 – INTERNATIONAL OWNERSHIP BODY (IOB) FORMED AND INITIAL INSTALLMENT OF TOTAL SYSTEM FINANCING
– SATELLITE AND LAUNCH SERVICES CONTRACTS SIGNED BY TONGASAT ON BEHALF OF IOB

1992 - 1993 – ADDITIONAL SIGNATORIES SIGN IOB AGREEMENTS AND MAKE ADDITIONAL INSTALLMENTS OF SYSTEM FINANCING

1993 - 1994 – CONSTRUCTION OF TT & C COMPLEX AND LAUNCH OF 1 OR 2 SATELLITES

LATE 1993 - 1994 – COMMENCE OPERATIONAL SERVICES

1995 - 1998 – LAUNCH OF ADDITIONAL SATELLITES AND EXPANSION OF SERVICES

asia - pacific regional satellite system

REGULATORY & INSTITUTIONAL

- **GOVERNMENTS ALLOW USER ACCESS**
- **BY - PASS LONG LAND - LINES**
- **COMMUNITY OR CUSTOMER PREMISE EARTH STATIONS**
- **EACH COUNTRY DESIGNATE SIGNATORY**
  - **GROUP OF COMMERCIAL CARRIERS**
  - **GOVERNMENT ENTITY**
- **GOVERNMENTS REGULATE TARIFFS**
- **SIGNATORIES TO REGIONAL SYSTEM SET CHARGES TO RETURN 14%**

INTERNATIONAL OWNERSHIP BODY (I O B) FINANCIAL/INSTITUTIONAL ASPECTS

- ANY ENTITY CAN PARTICIPATE IN FINANCING OF IOB TOTAL SYSTEM
- PREFER 5 TO 10 INVESTORS FOR ENTIRE $400 - $600 MILLION IOB SYSTEM – REAP ROI OF 14%
- EACH COUNTRY MAY APPOINT SIGNATORY
  - EITHER INVESTOR IN IOB
  - OR NON-INVESTING CARRIER'S CARRIER OR GROUP OF CARRIERS
  - OR EACH END USER AUTHORIZED TO DEAL DIRECTLY WITH IOB
  - OR GOVERNMENT ENTITY
- TONGASAT UNDER CONTRACT AS INITIAL SYSTEM MANAGER
- ANY INVESTING SIGNATORY COULD PROVIDE TT & C

THE RETURN OF PEACESAT

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1. ABSTRACT

The Pan-Pacific Education and Communications Experiments by Satellite (PEACESAT) Program was founded by the University of Hawaii in 1971 and provided a single-channel, push-to-talk satellite telecommunications network which served over twenty Pacific Island locations. PEACESAT used the ATS-1 satellite for the exchange of social, environmental, health, and educational information until August 1985, when the satellite ran out of station-keeping fuel and had to be silenced.

In 1987, the U.S. Congress appropriated funds to the National Telecommunications and Information Administration (NTIA) of the Department of Commerce for the restoration of PEACESAT service. Through the cooperation of the National Oceanic and Atmospheric Administration (NOAA), another division of the Department of Commerce, PEACESAT service is now being reestablished using the S-band frequencies of the GOES-3 satellite. The satellite was repositioned to 175 degrees West longitude; and new, low-cost earth terminals were developed to work at the GOES frequencies by a manufacturer in New Zealand. NTIA funded the purchase of twenty-seven terminals for the purpose of restoration of PEACESAT in the Pacific Islands. With the GOES system, signal quality and system flexibility are greatly improved from the ATS-1 technology. Each PEACESAT user has the capacity for selecting one of several program networks at a time, including voice or high speed data transmission services, and is able to transmit one channel of voice or data at a time.

2. BACKGROUND

When NASA launched its first Applications Technology Satellite (ATS-1) in 1966, nobody in the Pacific area even dreamed that it would serve to introduce communications by satellite to the small island countries of that vast area. However, three years later NASA completed its experiments, and requested proposals for additional experiments to be conducted on the satellite. The University of Hawaii submitted a proposal to conduct the Pan-Pacific Education and Communications Experiments by Satellite. In 1971 the proposal was approved, and the PEACESAT Program was born. For the next fourteen years, until August 1985, PEACESAT provided educational, medical, environmental and emergency communications to non-profit organizations in the Pacific Islands on a non-cost basis. Operating in a mesh-type system, various networks evolved which spanned the equator, the dateline, thousands of miles of ocean, and old colonial boundaries. PEACESAT provided unprecedented connectivity to the people of the Pacific with affordable, appropriate technology, with each member of the network providing its own support.

In mid-1985, the ATS-1 ran out of station-keeping fuel, and began an uncontrolled drift away from the Pacific area. On August 1 of that year, the satellite was silenced, leaving its many users without their voice to the outside world.

In December 1987, recognizing the importance of the PEACESAT Program to the Pacific Islands, the U.S. Congress authorized funds ($3.4 mil) for the reestablishment of PEACESAT, and designated the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce as the administering agency. The Congress appropriated $1.7 million to NTIA for FY 88, $200,000 in FY 89, and $1 million for FY 91 for the restoration of PEACESAT services.

In early 1988, after the Congressional authorization, the ATS-1 completed its orbit of the earth and again appeared over the Pacific, providing PEACESAT with the unique opportunity to reactivate the network through the ATS-1. During 1989 many of the ATS-1 terminals were reactivated, and PEACESAT users were reunited until the satellite once again drifted out of range in late 1989.

3. PRIOR PEACESAT SERVICE

The success of the PEACESAT system was based on the use of low-cost technology and the availability of a no-cost satellite. The ATS-1 terminals, which operated on VHF frequencies (149 MHz uplink, 135 MHz downlink), cost an average U.S. $3,000, and in several instances were assembled by enterprising amateur-radio operators from off-the-shelf equipment. These no-frills earth terminals operated on a single "push-to-talk" channel that could support voice and electronic data traffic. A typical ground terminal consisted of an amateur-radio type VHF transceiver, two Yagi antennas, a high power amplifier, preamps and packet switching equipment for data transmission. Because they were low tech, the ATS-1 terminals could be easily operated and maintained by operators located in the islands.

Throughout the Pacific these terminals were established by colleges, departments of education, medical centers and other public agencies, all of which were involved in instructional programming, cultural exchanges, medical information and emergency communications. PEACESAT delivered distance education programming from the University of the South Pacific and the University of Guam to remote campus centers throughout the Pacific. Before PEACESAT was shut down in 1985, there were more than 100 earth terminals operating on eight different networks. There were PEACESAT earth terminals in virtually every country and territory throughout the Pacific Islands, and in several of the Pacific Rim countries (Australia, Japan, New Zealand, and the United States).

After the ATS-1 satellite drifted out of the Pacific, PEACESAT was able to continue limited service to the Pacific Islands as far west as the International Dateline using the ATS-3 satellite. The ATS-3, a sister satellite to the ATS-1, continues in service from a location just west of Central America (at 105 degrees W. longitude), but is too far east to provide coverage of the islands in the Western Pacific. Unfortunately, the ATS-3 has run out of station-keeping fuel and so cannot be moved west to serve the entire Pacific basin.

4. REESTABLISHMENT OF PEACESAT

PEACESAT enlisted the support of Hawaii Senator Daniel K. Inouye who introduced legislation which provided for the reestablishment of the system. After the initial appropriation was made in 1987, PEACESAT and NTIA joined forces to search for a successor to ATS-1, a process that took the better part of two years.

PEACESAT and NTIA worked with the International PEACESAT Users Group (IPUG) to first define user service requirements and then searched for a satellite which could provide the required interconnection capacity. Satellites were reviewed on the basis of several criteria: potential availability; orbital position or potential position; earth coverage footprint; recurring space segment costs; earth terminal complexity and costs; spectrum availability; and operational status (interim or long-term potential on the basis of the satellite's ability to maintain orbital position and service). While the study reviewed information regarding several private sector satellites operating in 1988, none of them met all the PEACESAT criteria.

In the absence of any private sector alternative, strong appeals were made by NTIA and PEACESAT for another U.S. government satellite. One of the prime candidates was the GOES-3 (Geostationary Operating Environmental Satellite), which was owned and operated by the National Oceanic and Atmospheric Administration (NOAA), another agency of the U.S. Department of Commerce. The GOES satellite was appealing to PEACESAT because the satellite provided a global footprint and operated on frequencies that would permit the use of relatively small, inexpensive earth terminals.

NOAA responded to the needs of the Pacific Islands and approved the use of the GOES satellite for PEACESAT. In an extraordinary action, NOAA also permitted the temporary use of the meteorological frequencies for PEACESAT purposes. Without the support of NOAA, the current restoration of PEACESAT service would not be possible. In December 1989, NTIA and NOAA agreed that the PEACESAT Program could use the GOES-3 satellite through 1994 while a long-term solution was pursued. Through a cooperative agreement between NOAA and NTIA, the satellite was repositioned to 175 degrees West longitude, where it will be kept in geostationary orbit by the NASA station at Kokee, Hawaii.

Since the GOES satellite operates on frequencies used for meteorological purposes (1688 MHz downlink, 2030 MHz uplink), PEACESAT must operate on a non-interference basis. The orbital location (175 degrees W. longitude) was selected to protect other users of these frequencies while still providing coverage to the entire Pacific basin.

A major problem regarding the use of the GOES was the lack of any commercially available earth terminals which could operate on the GOES frequencies and with the GOES power levels. Before a final decision was made on the use of the GOES, a study was conducted by an equipment manufacturer on the feasibility of constructing a low-cost earth terminal. As a result of this study, the University of Hawaii issued a Request for Proposals in October 1989, for the design and manufacture of suitable earth terminals. After a thorough review of the proposals received, a contract was awarded to Marine-Air Systems, Ltd. (MAS), a small company in Lower Hutt, New Zealand, for the manufacture of twenty-seven earth terminals which would be placed in each of the former PEACESAT sites that wished to resume its PEACESAT activities.

Prototypes of the earth terminals were tested in September 1990, and the first operational units were installed at PEACESAT Hawaii in October, 1990. The MAS designed terminals meet or exceed each of the technical specifications developed by the PEACESAT users. *Figure 1* shows the desired service requirements specified by the International PEACESAT Users' Group at the outset of their search for an innovative ground segment compared with the resulting equipment provided by MAS. *Figure 2* compares the costs of current PEACESAT technology.

When PEACESAT sought funds from the U.S. Congress to reestablish PEACESAT service, the users pledged that each location would contribute U.S. $5,000 toward the acquisition of earth terminals. The Congressional funding was sufficient to subsidize GOES earth terminals in 23 Pacific Island locations and to purchase four terminals for network hub operations, command and maintenance.

In the early stages of reestablishment, a large part of the responsibility will be placed on the PEACESAT headquarters at the University of Hawaii. The International PEACESAT Users' Group (IPUG) recently convened in Honolulu, Hawaii at a PEACESAT/Marine-Air Systems (MAS) GOES-3 satellite space and ground segment training workshop with sixteen island countries represented. Top priorities for IPUG were: a) support of the PEACESAT Honolulu headquarters management staff in reestablishment of the technology; b) the continued development of management and technical systems, such as the data communications system; c) the search for a long-term solution; and, d) the development of alternative funding support beyond the Congressional appropriations.

Reestablishment of the PEACESAT networks on PEACESAT GOES begins with four Pacific Island sites in December, two in January, nine in February, and the remaining ten sites in March, 1990. Redundancy will be emphasized wherever possible. The GOES satellite has two transmitter/receiver systems. Two complete GOES terminals have been installed at the PEACESAT hub at the University of Hawaii. Many island locations still have single side band HF equipment, which was installed after the ATS-1 satellite was no longer available, or can communicate with PEACESAT through the still operating ATS-3 system, *Figure 3*. Pacific Island PEACESAT managers and operators trained at the satellite workshop in October, 1990, will install the GOES earth terminals.

All the PEACESAT sites must file an application with the University of Hawaii for reestablishment. After a PEACESAT Pacific Island site has submitted a letter of intent committing U.S. $5,000 and they have been approved as a PEACESAT GOES site, the next step in reestablishment is approval for frequency use, which must be obtained from local licensing authorities. *Figure 4* documents the frequencies currently in use by PEACESAT. Since the frequencies PEACESAT is using on the GOES

FIGURE 1
PEACESAT USER REQUIREMENTS CHART

MINIMUM SERVICE REQUIRED	SERVICES PROVIDED ON GOES
SATELLITE REQUIREMENTS: Position: 150 West - 140 East degrees longitude Inclination Tolerance: +/- 13 degrees	**GOES-3** 175 West degrees longitude +/- 8 degrees
NETWORK CONNECTIVITY: Interactive Mesh, Global Coverage	**NETWORK CONNECTIVITY:** Interactive Mesh, Global Beam, ie, covers 1/3 of Earth's surface
FADE MARGIN: 6 db	**FADE MARGIN:** 7 db
SIGNAL TRANSMISSION: 50 KHz linear translator bandwidth 100 KHz desired Voice: Half-duplex required Full-duplex desired Data: Half-duplex 1200 required Full-duplex 64 kbps desired	**MAS EQUIPMENT:** Multiple 25 KHz channels within the satellite's 8 MHz Translator bandwidth Voice: Half or Full-duplex Data: Half-duplex, 2400 bps Full-duplex, 9600 bps
CHANNEL ASSIGNMENTS: The minimum would allow users to divide up the bandwidth for channel assignments for either analog or digital services to meet user requirements at any one time in the area of voice, data, slow scan and compressed video.	**MAS EQUIPMENT:** Capable of running channels with voice, data, FAX, slow scan and compressed video. Satellite supports multiple channels for simultaneous uses.
SIGNAL-TO NOISE RATIO: Greater than 20 db	**MAS EQUIPMENT:** Greater than 30 db
ASSEMBLY/MAINTENANCE: Low cost, low technology, low maintenance	**MAS EQUIPMENT:** Low cost, low maintenance, low tech., except S-Band Electronics.

satellite are allocated by international agreement for meteorological use, PEACESAT's use is only temporary through 1994 and must be on a non-interference basis. PEACESAT and NTIA are working closely with the U.S. Department of the Interior and the Federal Communications Commission for the licensing of terminals in jurisdictions where frequencies are coordinated by the United States. PEACESAT ground station management will have to work closely with the Departments of Education and Communications to receive approval from counterpart regulatory agencies in the non-American Pacific Islands.

While Pacific Island terminals are obtaining licensing authority to access the GOES-3 frequencies, the sites will receive their GOES ground segment equipment and install it. The equipment manufactured by Marine-Air Systems, Ltd. has been designed to make both installation and maintenance a task a lay person could perform. NTIA and PEACESAT have supported a training video to accompany the delivery of the MAS equipment.

The PEACESAT GOES ground segment equipment will provide good and reliable telephone quality service for push-to-talk and full-duplex: voice programming; interactive computerized in-house PEACESAT scheduling; electronic messaging; interactive database access; facsimile; slow scan and video phone; automated medical and environmental emergency support; and, automated data and voice access to all of the above services on a 24-hour basis.

No PEACESAT GOES terminal can transmit on more than one channel at any one time. The full PEACESAT GOES system is designed to carry up to nine half-duplex and three full-duplex channels

FIGURE 2
CURRENT PEACESAT GROUND STATION EQUIPMENT
ESTIMATED COSTS FOR VARIOUS TECHNOLOGIES

	HF **SINGLE SIDE BAND** (High / Low)	**VHF-UHF ATS-1/ ATS-3**	**S-BAND** GOES-3
Indoor electronics			$4,318
Transceiver	$3,500/$1,500	$ 550	
Power Supply	600/ 120	360	
Amplifier		255	
Pre-Amplifier		90	
Phone Patch		125	
Packet Modem w/ interface		240	
V.42*bis* Modem			1,650
Microphone			75
Antenna*	5,400/ 225	370	
Antenna Tower	2,400		
Antenna & Electronics			12,728 (3 meter antenna)
Actuator**			1,580
100′ Coax	90/ 75	100	
TOTAL* **	$11,990/$1,920	$2,090	$20,351

* SSB High End Antenna - Log Periodic
Low End Antenna - Dipole

** Necessary for tracking satellite through an inclined orbit.

*** Add 15% for turnkey cost; GOES total does not include antenna pad or shipping.

on the satellite. However, this level of service has not yet been tested due to the limited number of operating terminals, and the number of channels ultimately used will be dependent on the level of intermodulation interference experienced when so many channels are operating.

Future services for research and development are: broadcast data in the form of bridging networks and multi-point-to-multi-point data communications; and compressed digitized video in the form of medium freeze-frame video.

The University of Hawaii PEACESAT headquarters will house two PEACESAT GOES terminals. One will be used to monitor for medical and environmental emergency programming, and the other will be used for program participation by the user community in the State of Hawaii. The hub data communications system providing the above data services will also be housed in Honolulu. PEACESAT Honolulu will gateway such services as the University of Hawaii Library On-Line Catalogue Service. As user demand is assessed these data communication services will expand.

Both hub and user software will be made available to PEACESAT GOES sites. Since PEACESAT is based upon an interactive mesh network, it is important that other resource countries offer hub data communication resources as well. For example, New Zealand has offered access to its National Library Services, and the Solomon Islands has offered fisheries databases.

Although the PEACESAT Honolulu GOES station will be staffed at least eight to ten hours a day, access to the hub will be necessary throughout the long Pacific day, which moves through several time zones. Guam is getting up when Honolulu is eating lunch. It was imperative then to automate the headquarters terminal so that any remote site will be able to access the Honolulu PEACESAT GOES site through voice and/or data services on a 24 hour basis.

In preparation for the restoration of PEACESAT service, PEACESAT management and IPUG have been working for the past year on the development of programming services. Pacific Island government and non-profit user demand currently shows a need

FIGURE 3

PEACESAT GOES RE-ESTABLISHMENT

ATS-1 SITES PRIOR TO 1985	SSB SITES	1989 ATS-1 RE-ESTABLISHMENT VHF/UHF SITES ATS-1/ATS-3		GOES-3 SUBSIDIZED SITES	PROPOSED DELIVERY DATE
		★	♦		
Alaska					★
American Samoa		★	♦	■	12/90
Australia		★			★
Belau	●	★		■	2/91
Canada					★
Chuuk	●	★		■	2/91
Cook Islands	●	★	♦	■	3/91
Fiji				■	3/91
Guam	●	★		■	12/90 2/91
Japan					★
Kiribati				■	3/91
Kosrae	●	★		■	2/91
Marshall Islands	●	★		■	2/91
New Caledonia		★		■	3/91
New Zealand		★			★
Niue				■	3/91
Northern Marianas	●	★		■	2/91 2/91
Papua New Guinea				■	3/91
Pitcairn Island		★	♦	■	3/91
Pohnpei	●	★		■	2/91
Solomon Islands		★		■	1/91
Thailand					★
Tonga		★	♦	■	12/90
Tuvalu				■	3/91
U.S. - Hawaii	●	★	♦	■	10/90 10/90
U.S. - Mainland					★
Vanuatu		★		■	1/91
Western Samoa		★	♦	■	12/90 12/90
Yap	●	★		■	2/91

★ PEACESAT has received expressions of interest from this area to locally fund a terminal at a future time.

FIGURE 4

PEACESAT FREQUENCY ALLOCATIONS

SINGLE SIDE BAND		ATS-3			GOES-3		
Chan-nel	Frequency MHz	Chan-nel	RX Freq MHz	TX Freq MHz	Chan-nel	RX Freq MHz	TX Freq MHz
1	3.9755	1	135.555	149.175	0	1694	2031.175
2	5.3315	2	135.575	149.195	1	1689.95	2031.95
3	7.4095	3	135.600	149.220	2	1689.9	2031.9
4	9.4095	4	135.625	149.245	3	1689.85	2031.85
5	12.1645	5	135.645	149.265	4	1689.9	2031.8
6	13.4305				5	1689.75	2031.75
7	18.3595				6	1689.7	2031.7
					7	1689.65	2031.65
					8	1689.6	2031.6
					9	1689.55	2031.55
					A	1689.5	2031.45
					B	1689.45	2031.5
					C	1689.4	2031.35
					D	1689.35	2031.4
					E	1689.3	2031.25
					F	1689.25	2031.3

for programming in the areas of environmental and medical emergency support, disaster preparedness and prevention measures, art, community service, culture, development, credit/no-credit distance education, health, cross-cultural social issues, remote site field support, research, institutional support, resource-sharing information, science, and technology. PEACESAT management will constantly monitor demand for programming. Emerging issues and concerns will be constantly reviewed by PEACESAT IPUG management and developed into active programming. *Figure 5* gives a partial sample schedule of PEACESAT programming, 6 hours of a 24 hour day on four voice channels and two data channels.

PEACESAT is concentrating on the reestablishment of terminals in the Pacific Islands. However, as seen from *Figure 6*, the GOES footprint covers countries from North America, the Pacific and eastern Asia. PEACESAT anticipates that non-profit organizations in these other areas may be interested in participating in the PEACESAT programming exchanges.

5. Challenges of the Future

The reestablishment of the PEACESAT networks presents some very real challenges. For the last five years, PEACESAT has been without a reliable space segment to support its pan-Pacific networks. The ATS-3 served the eastern Pacific (the Samoas, Tonga, Cook Islands, and Hawaii), the Single Sideband radio linked Hawaii and Micronesia, and the drifting ATS-1 was not available long enough to reestablish very much meaningful programming. During the five-year period several of the terminal operators in the Pacific were reassigned to other jobs. In some parts of the Pacific, PEACESAT is only a memory.

The first task is to assure the former PEACESAT users that the services have been reestablished, and that the system will provide reliable, high quality voice and data communications. Once the new GOES system becomes operational and the earth terminals and programming are demonstrated, it is anticipated that all of the former ATS-1 users will join the system.

A tremendous amount of remote site local institutional and government support will be required to assist PEACESAT headquarters in re-establishing all of the past ATS-1 sites. Although the new GOES earth terminal equipment has been subsidized by the U.S. Government, each site is still expected to provide a significant amount of support. In addition to the $5,000 contribution, each site is expected to provide a concrete pad for the GOES antenna, a suitable building for housing the equipment, an operator, a personal computer and facsimile machine, and insurance against loss or damage of the equipment. For some of the less developed countries in the region, these requirements will not be easily met.

In the reestablishment process, PEACESAT has by necessity devoted considerable time to obtain the hardware systems required to support the restoration of satellite service. The emphasis must now turn to programming, management systems, and extensive remote site training in order to transfer this technology and its applications to the users. The new and improved technology made available through the GOES system will undoubtedly give rise to new needs and types of programming which must be developed to meet those needs.

FIGURE 5
PARTIAL SAMPLE SCHEDULE PEACESAT PROGRAMING FOR GOES-3, 6 HOURS OF 24 HOURS

GMT HOUR ----------- VOICE CHANNEL	2200-2300	2300-0000	0000-0100	0100-0200	0200-0300	0300-0400
1	SEA GRANT- Ocean Resources-Coastal Zone Management	AGRICULTURAL DEVEL. IN THE AMERICAN PACIFIC (ADAP)- Land Grant Development	RED CROSS- Emergency Techniques for Remote Sites	DISTANCE EDUCATION- Travel Industry Management	CONSORTIUM OF PACIFIC EDUCATORS (COPE)- Computer Labs: Set Up, Maintenance, and Training	CENTER FOR DISEASE CONTROL (CDC)- AIDS: Research and Control in the Pacific
2	MEDICAL TECHNOLOGY- Hematology	DISTANCE EDUCATION - Aquaculture: Prawn Farming	SPACE COLLEGE- Identifying Volcanoes from Space	FORUM FISHERIES- Pacific Congress on Marine Science and Technology	SOUTH PACIFIC REGION AGRICULTURE DEVEL. PROGRAM (SPRAD)- Agriculture Technology Transfer	PACIFIC BASIN DEVELOPMENT COUNCIL (PBDC)- Pacific Ocean Oil Spills
3	PACIFIC TSUNAMI WARNING CENTER (PTWC) Tidal Gauging	ENVIRONMENTAL PROTECTION AGENCY (EPA)- Drift Net Fishing	CENTER FOR THE ADVANCEMENT OF PACIFIC EDUCATION (CAPE)- Alternative Ed. for Special Kids	FAMILY PEACE CENTER- Child Abuse Prevention	PACIFIC ISLAND STUDIES- Oral History Research	PACIFIC INSTITUTE OF CHEMICAL DEPENDENCY- Pacific Basin Substance Abuse
4	CURRIULUM RESEARCH DEVELOPMENT GROUP (CRDG)- Creating Island Curriculum	PACIFIC BUSINESS CENTER- Business Finance	PEACECORP- Computer Network Training	RENEWABLE ENERGY- Wind Power Research	CIVIL DEFENSE: Region 9- Developing an Infrastructure	DISTANCE EDUCATION- Student Nurses Practicum Exchange
DATA CHANNEL						
1	CIVIL DEFENSE- Disaster Preparedness Warning Systems	FORUM FISHERIES AGENCIES- Coastal Management Data Exchange	LIBRARY NETWORK- Interactive Database Exchange	MICRONET DISTANCE EDUCATION- International Marketing: Course Evaluation	PEACESAT USER BULLETIN BOARD & MESSAGES Scheduling, Electronic Messaging, Bulletin Board Access	PACIFIC TSUNAMI WARNING CENTER (PTWC)- Tsunami Drill
2	SOUTH PACIFIC REGION AGRICULTURE DEVEL. PROGRAM (SPRAD)- Agricultural Liaison Officer (ALO) Data Collection	PACIFIC SCIENCE CONGRESS- On-Line Conference Remote site Needs Assesment	PACIFIC ISLAND CENTER FOR HIGH TECHNOLOGY RESEARCH (PICHTR)- Technology Transfer	CENTER ON AGING- Geriatric Statistics in the Pacific Islands	SEA GRANT- Marine Center Research--Giant Clam Project	UNIVERSITY OF THE SOUTH PACIFIC (USP)- Interactive Database Access

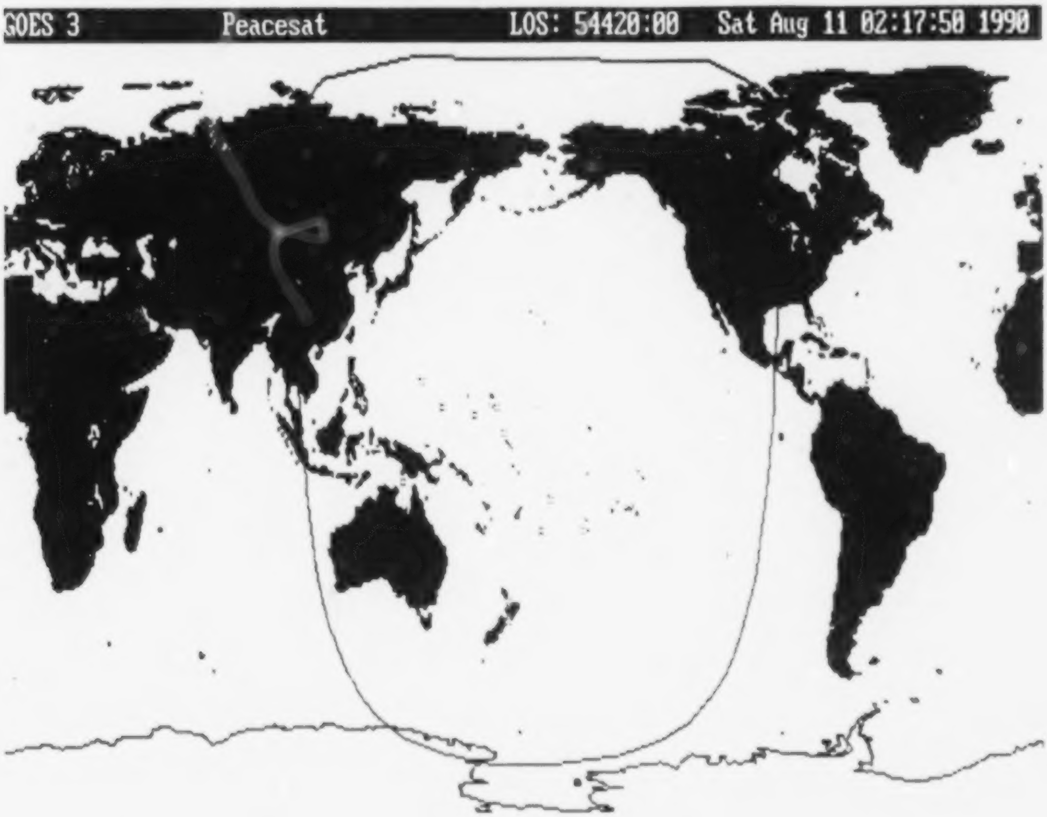
PEACESAT must also convince the users that this is not just another short-term arrangement that will soon pass. Barring the unexpected failure of the satellite, the GOES system is guaranteed for at least the next four years. PEACESAT anticipates a long-term solution in sight before the end of 1994, a solution that will carry PEACESAT well into the 21st century. It is hoped that after minor modifications, the MAS S-band earth terminals can be used with any post-GOES system.

Another challenge to the continuation of PEACESAT is funding. Although each site is self-supporting, NTIA is currently funding NASA's telemetry and command of the GOES satellite. It is not known at this time how long Federal support for this expense will continue or what level of funding might be required from PEACESAT.

Alternative funding to support the PEACESAT networks and their programming will be sought through foundations, science and technology funding agencies, individual users, and through developed and developing country government and non-profit support agencies.

Two considerations have frustrated PEACESAT efforts for alternative funding to date: 1. PEACESAT has been restrained from seeking alternative funding until a satellite network system was established; and 2. funding agencies which support grants of the size necessary for PEACESAT support do not fund projects which are international in the scope PEACESAT involves. Rather, they tend to fund specific countries or combinations of countries.

Figure 6
GOES-3 FOOTPRINT COVERAGE



The GOES satellite position at 2:17 p.m. on August 11, 1990, was at 176 degrees West (nominal position, 175 degrees West longitude, +/- 1 degree) and 6 degrees North latitude, due to inclination of orbit.

6. CONCLUSION

Thanks to the efforts of numerous individuals in the U.S. Congress, NTIA, the University of Hawaii, and many of the Pacific Island sites, PEACESAT has returned to the Pacific. With the new GOES system made available by NOAA, the underserved people of the Pacific Islands will once again be linked through satellite communications. The services provided by the GOES system represent a major improvement over those of the old ATS-1, and will bring new methods of networking across the vast expanse of ocean that separates the island communities. After the five-year hiatus, PEACESAT has been revived.

While PEACESAT now has a new lease on life, there is no time for complacency over recent accomplishments. Much work remains to be done. The new terminals are being constructed and installed. Rebuilding the networks is underway. New programming is being developed. Moreover, there is the long-term future to be considered. The search for a system beyond 1994 has already begun, and will not cease until a solution is in hand. Hopefully, this will be the topic of a PEACESAT report to a future PTC.

LOW-COST SATELLITE COMMUNICATION SYSTEM FOR PAN-PACIFIC INFORMATION NETWORK AND ITS EXPERIMENT USING ETS-V SATELLITE

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ABSTRACT

The Pan-Pacific Information Network, which is a non-profit satellite communication system and is almost the same concept as PEACESAT, is desirable to be constructed by using low cost and simple earth stations for mutual communication and information exchange in the field of education, research and health in the Pacific region. We have proposed two ideas to make the network realizable: (1)A satellite hitchhiker payload, which is a transponder dedicated to the network onboard an appropriate communication satellite as a hitchhiker. (2)Any volunteer group prepares the earth station to make its cost low. To clarify the more detailed technical feasibility as the follow-on study of our proposed ideas, we design and manufacture the earth station. The Communications Research Laboratory conducts the experiment using the Engineering Test Satellite-V (ETS-V) in cooperation with the Social Science Research Institute, University of Hawaii. This paper describes, first, the purpose and plan of the experiment and design of the low-cost L-band earth station. The demonstration experiment of TV conference using 64 kb/s satellite link through ETS-V is conducted between University of Hawaii and the site of the Symposium on the Establishment of a Pan-Pacific Information Network held in Kobe, Japan, in November, 1990. Second, the paper discusses the issues to be taken into consideration for preparing the earth station by volunteer group, focusing on the actual cost of the earth station.

1. INTRODUCTION

The Pan-Pacific Information Network, which is a non-profit satellite communication system and is almost the same concept as PEACESAT (Pan-Pacific Education and Communication Experiment by Satellites), is desirable to be constructed by using low cost and simple earth stations for mutual communication and information exchange in the field of education, research and health in the Pacific region. Such a Pan-Pacific Information Network would primarily have no conflict of interests, while it is useful for the academic and cultural exchange among the people in the region. PEACESAT is going to re-establish its network by using GOES-3 satellite. However, we have not yet heard that the satellite for the future network beyond several-year operation of GOES-3 was determined.

In order to obtain the satellite facility, there might be many problems especially in the budget. Considering such problems, in our previous paper(1) presented at PTC'90, we proposed the following two ideas as a more realizable method to establish the Pan-Pacific Information Network.

(1) A hitchhiker payload: which means to bear a dedicated transponder onboard an appropriate communication satellite.

(2) Earth stations should be prepared by the volunteer group.

In particular, it can be expected that the second proposed idea will contribute to reduce the cost of the earth station to approximately one-tenth of the cost which is newly designed by the professional manufacturer. We also proposed that the earth station could be configured by applying the amateur radio equipments and that the authorized organization such as Communications Research Laboratory (CRL) offers the technical support for preparation. Moreover, this proposal would contribute to make the maintenance of the earth station easy, if at least one of the earth station users joined the volunteer group.

We have considered the system which consists of a geostationary communication satellite and the simple earth stations widely distributed in the Pacific region. We assume that the system is configured by using no hub stations, so that all of the participants of the network can be equal partners and the subnetwork can be operated independently. The transmission rate of 64 kb/s would be preferable for the future applications easily linked to the ISDN (Integrated Services Digital Network). The paper(1) described the technical feasibility study of the hitchhiker payload. As a result, it was clarified that the frequency of S band would be the most practical through the trade-off study and a hitchhiker payload could be designed technically. The hitchhiker payload would have approximately 3 kg of weight and 50 W of power consumption for a 2-channel transponder including an onboard antenna. Its cost would be around 300 million Yen or $2 million. The earth station could be configured by applying amateur radio equipments and its cost for all of the electronic components has been estimated to be around 1,000,000 Yen or $6,900.

This paper has a purpose to clarify the more detailed technical study of our proposed idea. We give our attention to the realization of earth station through designing and manufacturing it as the follow-on study to the paper(1). Moreover, the CRL conductsan experiment using the Engineering Test Satellite-V (ETS-V) in cooperation with the Social Science Research Institute (SSRI), University of Hawaii. This paper, in the first place, describes the design and manufacture of the low-cost earth station on the basis of the design principle proposed by the previous paper(1), which is to apply the amateur radio equipment to the earth station. However, instead of the S band, the L band frequency is selected for the experiment using ETS-V. We configure two earth stations made by hand of researchers of the CRL. The actual cost of the earth station can be shown in the paper. The paper also describes the demonstration experiment of Pan-Pacific Information Network using ETS-V and the earth stations which is conducted in November 1990 between University of Hawaii and the site of the Symposium on the Establishment of a Pan-Pacific Information Network (PAN-Net'90) which takes place in Kobe, Japan. TV conference using a both-way 64 kb/s satellite communication link through ETS-V is demonstrated.

In the second place, the paper reviews the experience that a volunteer group prepares the earth station in terms of issues including availability and development duration. We discuss the actual cost of the earth station.

2. EXPERIMENT OF PAN-PACIFIC INFORMATION NETWORK USING ETS-V

2.1 Objectives of Experiment

This experiment is conducted using ETS-V in the L band frequency as described later. The first idea of the experiment stems from the desire to realize a low-cost and simple earth station as we proposed: Can we design and assemble the earth station by using off the shelf parts in the market in actuality? How much is the actual cost of the earth station? How long does it take to manufacture such an earth station? Through these experiment, we expect to make the detailed requirement of the hitchhiker payload clear.

The second idea of this experiment is how the digital technology be applied practically to the Pan-Pacific Information Network. It includes (i)64 kb/s video conference, (ii)9.6-64 kb/s data transmission and computer communication, and (iii)4.8-16 kb/s digital voice code and decode technique.

We can now summarize the objectives of the experiment to the following points:

(1)Applicability of 64 kb/s satellite communication link.

(2)Operationability of L-band (1.6/1.5 GHz) frequency.

(3)Possibility of manufacturing the simple and low-cost earth station.

(4)Requirement of a future satellite transponder.

2.2 Experiment Plan(2)

The ETS-V satellite, shown in Fig. 1, was launched by NASDA (National Space Development Agency of Japan) on August 27, 1987. Its weight is approximately 550 kg in the geostationary orbit and the location is 150 degree East. It bears L-band transponders and an L band antenna. Many experiments including mobile satellite system have been conducted(3). The status of ETS-V as of August, 1990, is in fairly good condition on the whole. If we do not perform North-South station keeping in about one year, which means not to maintain the latitude of the satellite within +/-0.1 degree, the ETS-V will be able to be operated for about 3 years.

The L-band antenna beam coverage of the ETS-V satellite is shown in Fig. 2. The ETS-V has two L-band beams: North (N) beam and South (S) beam. The feeder link of the satellite is C-band. In this experiment, the C-band is not used and the L/L mode, which means bent-type mode in the only L-band, is used. This is why the future hitchhiker payload is designed to be used for no hub station and to operate in the only one frequency band.

Figure 2 shows the N-beam antenna gain at Hawaii is still approximately 17 dBi. This antenna gain equals approximately the gain of a global coverage beam antenna and the link must, therefore, be established between Hawaii and Japan.

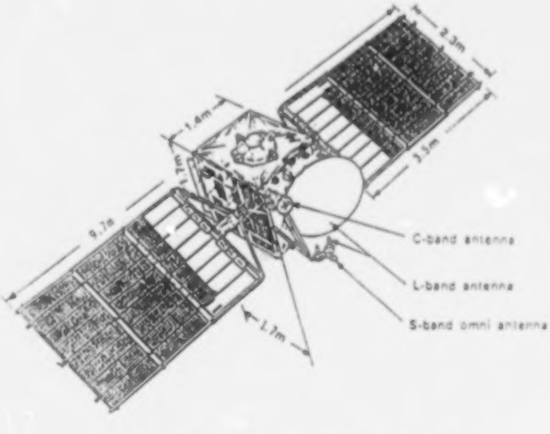

FIGURE 1 CONCEPTUAL VIEW OF ETS-V.

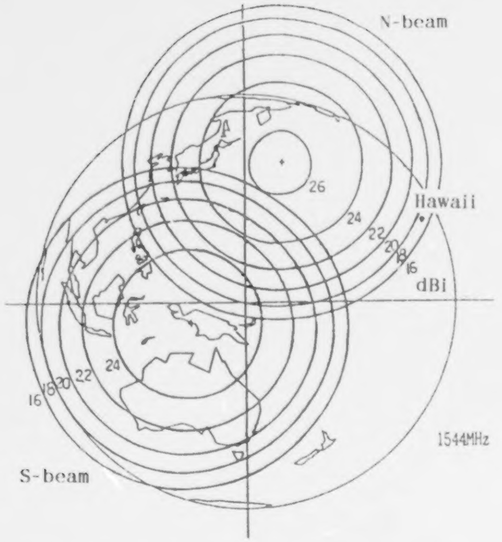
N-beam
Hawaii
26
24
22
20
18
16
dBi
24
22
20
18
16
1544MHz
S-beam

FIGURE 2 L-BAND BEAM COVERAGE OF ETS-V.

TABLE 1 LINK BUDGET.

Transmit Earth Station	Tokyo	Hawaii	
Receive Earth Station	Hawaii	Tokyo	
Transmit Power	3.7	8.8	dBW
Earth Station EIRP	30.9	36.0	dBW*1
Up-Link Path Loss	188.3	188.5	dB
Satellite G/T	-5.5	-13.4	dB/K
Up-Link C/N₀	65.7	62.6	dB.Hz
Satellite Output Power	7.6	4.5	dBW*2
Satellite EIRP	19.7	23.6	dBW
Path Loss	188.0	187.7	dB
Earth Station G/T	3.2	3.2	dB/K*1
Down-Link C/N₀	63.5	67.7	dB.Hz
Total C/N₀	61.4	61.4	dB.Hz
Required C/N₀	54.0	54.0	dB.Hz*3
Margin	7.4	7.4	dB

*1 Earth station antenna diameter = 3 m.
*2 Satellite HPA back-off = 2dB.
*3 QPSK and BER = 1×10^{-4}.
Implementation loss = 2dB.
FEC: Convolutional coding (R=1/2, K=7).
Viterbi decoding (soft decision).

This discovery has been the starting point of this experiment. In the Japanese side, the CRL develops two earth stations. One of the earth stations is to be installed at the PEACESAT site of the SSRI. Another is positioned in Japan. According to the link budget shown later, the 64 kb/s link can be accommodated sufficiently by using 3 m antenna in both side of Hawaii and Japan. The configuration of the experiment is shown in Fig. 3.

The Memorandum of Agreement (MOA) has been signed by both SSRI and CRL. The experiment is planned to be continued for at least one year commencing October, 1990. The item of the experiment includes academic data and voice communication. Tohoku University, University of Electro-Communications and Kobe University will be expected to join to this experiment, although the formal agreement with CRL has not yet been established.

2.3 System Design

The link budget of this system is shown in Table 1. The link can accommodate a both-way (full duplex) communication. The satellite power of 5.75 W is required for Tokyo link and 2.82 W for Hawaii to Tokyo link. The output power of the earth station in Tokyo and Hawaii is 2.34 W and 7.59 W respectively. This is why Hawaii is located at the low antenna gain position as men-

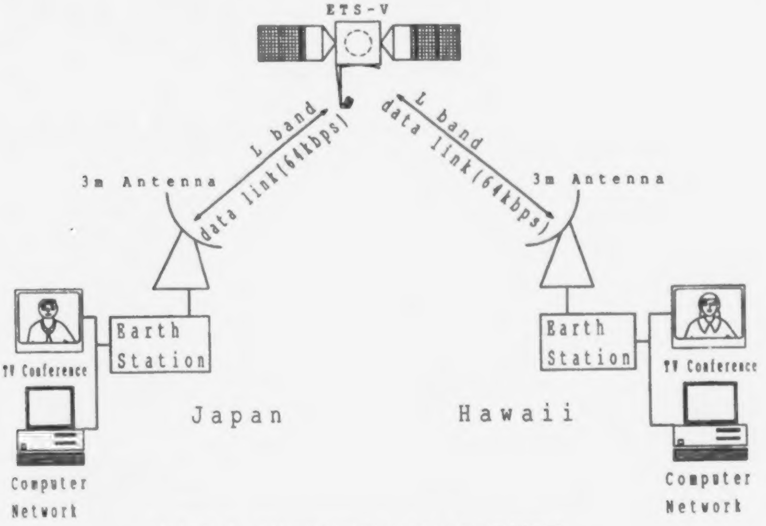
ETS-V
L band
data link(64kbps)
L band
data link(64kbps)
3m Antenna
3m Antenna
Earth
Station
Earth
Station
TV Conference
TV Conference
Japan
Hawaii
Computer
Network
Computer
Network

FIGURE 3 CONFIGURATION OF EXPERIMENT.

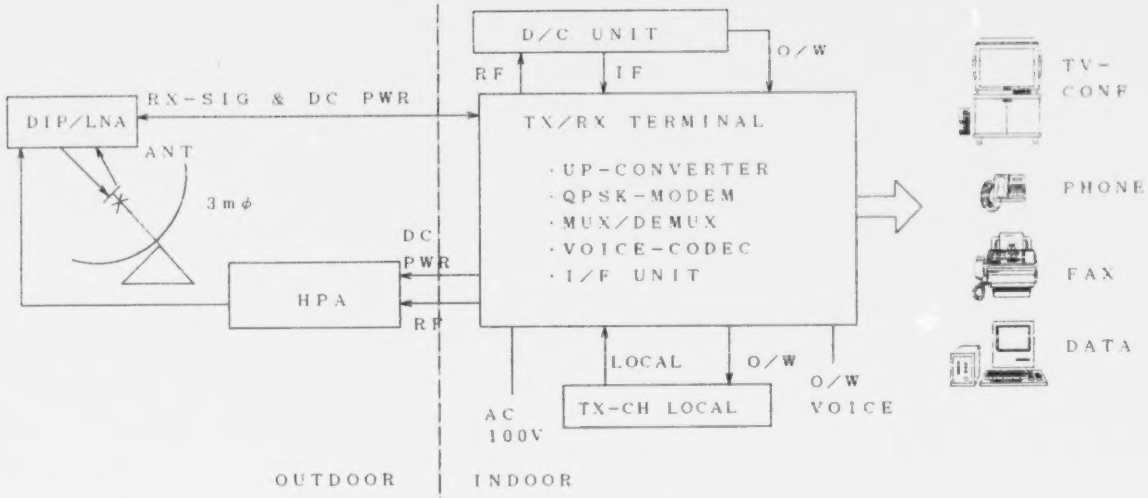

FIGURE 4 CONFIGURATION OF EARTH STATION.

tioned in **2.2**. The link margin of 7.4 dB is still available for QPSK (Quadrature Phase Shift Keying) and Bit Error Rate (BER) of 1x10^{-4}. The forward error collection (FEC) technique using convolutional encoding and Viterbi decoding is adopted.

2.4 Configuration of Earth Station(4)

The earth station has been designed by the researchers of CRL based on more than three-year experience of ETS-V mobile communication experiment. The configuration of the earth station is shown in Fig. 4 and its major characteristics are depicted in Table 2. The configuration of the earth station at both Hawaii and Japan is just the same. The feature of this earth station is to be simple and low cost. The antenna, transmitter and receiver are configured by the electronic components almost all of which can be available in the market easily. The frequency converter is configured by converting an amateur radio equipment. The modulation system is QPSK. The customized large scale integrated circuit (LSI) and logic array LSI are used to configure the modulator and demodulator (MODEM) and voice coder and decoder (CODEC).

TABLE 2 CHARACTERISTICS OF EARTH STATION.

Transmit Frequency	1644-1645.5 MHz
Receive Frequency	1542-1543.5 MHz
Antenna System	Transportable Parabolic Antenna of 3 m diameter
High Power Amplifier	Saturation Power of 16 W (A-class) using GaAsFET
Low Noise Amplifier	Temperature of 55K using GaAsFET
Modulation System	Data Link: 128kb/s, QPSK Order Wire (Voice): NBFM
Error Correction	Convolutional Encoding (R=1/2, K=7) Viterbi Decoding (Soft Decision)
Data Rate	64 kb/s

The terminal interface is serial input/output module with HDLC (High Level Data Link Control Procedures) protocol. The terminal mode can accommodate either analog mode or digital one. The analog mode is used for an order wire by FM (Frequency Modulation) system. The digital mode includes the following terminal modes: a telephone, a facsimile, computer data and a TV conference. The TV conference mode and the other modes can be used not simultaneously but alternately. The terminal mode except TV conference mode can be used almost simultaneously by a time division multiplex technique.

The outdoor unit of this earth station is consisted of a 3-m diameter dish antenna, HPA (High Power Amplifier) and LNA (Low Noise Amplifier) as shown in Fig. 5. The indoor unit, as shown in Fig. 6, includes a frequency-up converter, a QPSK-MODEM including a convolutional encoder and a Viterbi decoder, a MUX/DEMUX (multiplexer and demultiplexer), a CODEC, a general coverage receiver as a frequency-down converter and an FM voice demodulator, a VHF band transceiver for frequency synthesizer and FM voice modulator, and other interface unit. These receiver and transceiver are for amateur use. The TV conference can be conducted by using a pair of 64 kb/s TV telephone system (INVITE 64) as shown in Fig. 7. The Figures 5 and 6 shows the equipment installed at the site of University of Hawaii.

2.5 Demonstration Experiment

The first event of this experiment comes when the demonstration of TV conference is conducted at PAN-Net'90 held in Kobe, Hyogo Prefecture, Japan, on November 28-29, 1990. The PAN-Net'90 takes place to discuss and plan for the establishment of a Pan-Pacific Information Network which will stimulate the exchange of information in the Asia-Pacific region, contributing to closer ties and cooperation. The PAN-Net'90 is sponsored by the Organizing Committee for the Symposium which is consisted of Japanese organizations: the Hyogo Prefectural Government, the Pacific Society, the Pan-Pacific Forum, Hyogo International Association and Pacific Resource Exchange Center.

In the demonstration, a pair of 64 kb/s TV conference system (INVITE 64) is used for transmitting PEACESAT's real-time operation image onto the large TV displays at the symposium room. And the panelists in both sides of Hawaii and Kobe discussed through this satellite communication link.

3. REVIEW OF THE EXPERIMENT AND DISCUSSION ON ACTUAL COST OF THE EARTH STATION

To implement this experiment, we have overcome many hurdles. The major of them are as follows:

- Designing and manufacturing earth stations.
- Information exchange and coordination among many organizations.
- Radio license on the both sides of the U.S. and Japan.
- Equipment transportation and installation.
- Procurement of budget.

In this experiment, we have succeeded in designing and manufacturing the low cost earth station within very short period. It includes even a Viterbi decoder, a voice CODEC and a QPSK-MODEM. About seven of the CRL researchers worked together for manufacturing the earth station until midnight every day for two months to have two earth stations ready by the end of November. Moreover, they worked even Saturday and Sunday for last four weeks. The work includes circuit design, soldering the electronic components, assembling and testing it. At last we have obtained a well-designed digital hardware, although some portions to be adjusted are still remained. Almost all of the electronic parts are available in the market. However, we adopted the following newly developed devices: the L-band High Power Amplifier (HPA) module of 16 W of saturation output power and a diplexer of high isolation ratio of 60 dB. In addition to these devices, we developed six L band filters (four for each earth station) by mechanically cutting a brass block and silver gilding it and by testing and adjusting its electric performance in the laboratory.

The issues of manufacturing such earth station are (1)how to procure electronic parts in short period and (2)how to output the idea existed in the researcher's brain onto the documentation to share the work to many people. Furthermore, We should assign sufficient time to configure the earth station so that the volunteers can enjoy manufacturing it.

The total component cost of the earth station is estimated to be approximately 1,970,000 Yen ($15,200). This cost is not include the cost for optional apparatus such as a personal computer and a TV telephone unit, labor, transportation and installation. The cost of the earth station was estimated to be 1,000,000 Yen ($6900) in the previous paper(1). The difference between these comes from (1)Half-duplex for full-duplex, (2)1 W output power for 16 W of saturation output power, (3)The actual earth station in this paper includes a high grade general coverage receiver of 600,000 Yen ($4600). This cost may be reduced to be about 150,000 Yen ($1200). Our proposed idea was the reduction of labor cost by a voluntary work. However, the transportation and installation cost was tremendously high in actuality. Since, this experiment is an international one. It has been clarified that the reduction of these cost is the very important and is a further study item.

Through this experiment, we expect to obtain the data for the detailed requirement of the future S-band hitchhiker payload. Unfortunately, we have not yet gotten enough data due to insufficient duration of the experiment at the time writing this paper.

4. CONCLUSIONS

In this paper, we have mainly described the outline of the experiment of Pan-Pacific Information Network using ETS-V. This experiment is conducted in the cooperation with SSRI of University of Hawaii and CRL. We constructed two earth stations by researchers' hand making. The demonstration of TV conference through ETS-V is conducted between Hawaii and the site of the PAN-Net'90 held in Kobe, Japan, on November 28-29, 1990.

Through this experiment, we expect to get the complete data and know-how of designing, manufacturing, testing and operating the L-band, simple but digital earth station.

ACKNOWLEDGMENT

We would like to thank Prof. Topping, Ms. Mukaida and the PEACESAT people of University of Hawaii for their cooperation and encouragement. We also thank the people concerned of CRL, MPT, NASDA, Tohoku University, University of Electro-Communications, Kobe University, Hyogo Prefectural Government and the Organizing Committee of PAN-Net'90, Mitsubishi Electric Corporation for their support and cooperation. A part of this work is supported by the Okawa Institute of Information and Telecommunication and Research and Development Center for Radio Systems.

REFERENCES

(1)T.Iida, N.Kadowaki, H.Morikawa and Y.Nemoto: "A Study on the Hitchhiker Payload for Pan-Pacific Information Network", PTC'90, Jan. 1990.

(2)K.Kondo, R.Suzuki, T.Iida and Y.Nemoto: "Pan-Pacific Satellite Information Network Experiments Using ETS-V", 1990 Autumn Conv. of IEICE, B-196, Oct. 1990 (in Japanese).

(3)K.Kondo, R.Suzuki, Y.Hashimoto, Y.Matsumoto, T.Ide, M.Sakasai and S.Ohmori: "CRL's Mobile Satellite Communication Experiments Using ETS-V", AIAA 13th International Communication Satellite Systems Conference, AIAA-90-0775-CP, Mar. 1990.

(4)M.Iguchi, Y.Hashimoto, T.Ide, M.Sakasai and

S.Ohkubo: "Experimental System for Pan-Pacific Information Network Using ETS-V", 1990 Autumn Conv. of IEICE, B-197, Oct. 1990 (in Japanese).

Epilogue: The demonstration experiment has completely succeeded.

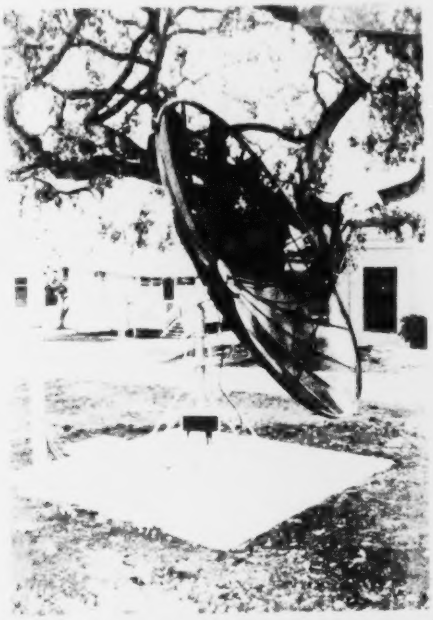

FIGURE 5 OUTDOOR UNIT OF EARTH STATION.

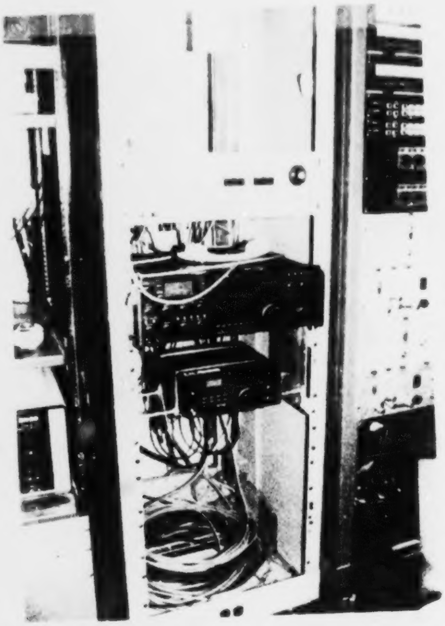

FIGURE 6 INDOOR UNIT OF EARTH STATION.

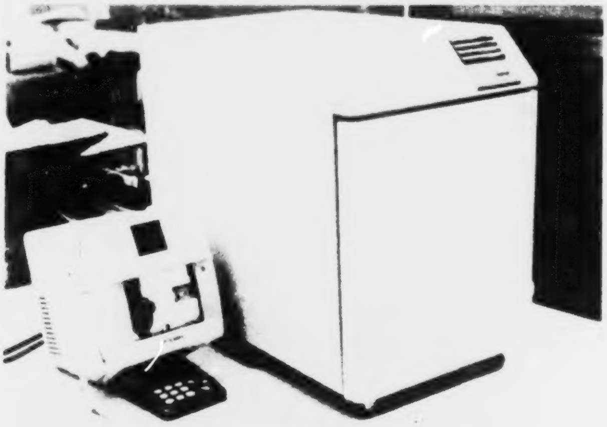

FIGURE 7 TV TELEPHONE TERMINAL.

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DESIGNING AN INEXPENSIVE AND INNOVATIVE S-BAND EARTH STATION NETWORK: THE CHALLENGE

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1. ABSTRACT

This paper outlines the design of SCPC-FM satellite earth stations for the PEACESAT network throughout the Pacific. Both voice and data communications are provided utilising the S-Band transponder on GOES satellites. The design includes many features to make the stations simple to operate and maintain by inexperienced users, as well as being tailored specially to the needs of distance education.

1. INTRODUCTION

Marine-Air Systems Ltd, a New Zealand based manufacturer of specialist electronic systems, competed for and won the contract to supply earth stations for the reinstatement of the PEACESAT Project. These small earth stations form a network of simple to use, low cost, terminals installed throughout the Pacific region as part of the Pan Pacific Education and Communications Experiments by Satellite (PEACESAT) project supported by the Social Science Research Institute, University of Hawaii. The stations, referred to as User Terminals, are installed at local educational institutions to provide a wide variety of activities including educational, health, and scientific programmes conducted via teleconferences. In addition the network supports medical and environmental emergency communications.

The Terminals communicate via a geostationary satellite at L-band and S-band. Operating modes include point-to-point and point to multi-point, offering speech, FAX, and data service. The following User Terminal capabilities are used to implement a variety of PEACESAT activities:

1.2 Teleconferencing

A channel common to all locations participating in a group discussion is assigned. Exchanges are by press-to-talk voice with a single carrier raised by each station in turn. This point-to-multipoint half duplex mode allows any station to speak to the group but only one station may speak at one time. Nine such channels can be selected on the Terminal.

1.3 Telephone

A point-to-point circuit can be established between two stations for direct person-to-person contact. A more personal and natural conversation can be conducted using the Terminal's telephone handset operating on one of the three point-to-point full duplex channels. In this mode the Terminal operates just like the familiar telephone. It is also easier for inexperienced or first time users who find press-to-talk operation daunting.

1.4 Phone Patch

Potential PEACESAT users who are remote from the campus where the User Terminal is located need not miss out on the facilities offered by PEACESAT. Users who are contactable by telephone can be connected to the Terminal via the built-in phone patch. FAX operation is also supported by the phone patch interface using un-modified CCITT Group 3 FAX machines.

1.5 Data Service

Both point-to-point and point-to-multipoint data connections can be established at rates up to 9600 bits per second to communicate between Personal Computers (PC's) or central host computers. Point-to-point connections are established over one of the three full duplex channels and allow standard PC based communications programs to operate. Point-to-multipoint connections require more specialised software but will allow larger numbers of locations to share data transmissions using packet switching techniques.

2. SPACE SEGMENT

The design of the new PEACESAT network is predicated by the availability of a spare GOES series weather satellite. If it were not for this satellite being made available by NOAA at minimal cost, the network would not be viable.

However, there is no such thing as a free lunch! The GOES-3 spacecraft is around 10 years old, and hardly representative of current microwave technology. The use of a redundant satellite designed for a different purpose, also places a number of constraints on the earth station design. The major difficulties with the satellite are:

> The satellite is running low on fuel. It is projected that only sufficient fuel is left for Longitude station keeping. To correct the orbital inclination would require considerably greater fuel reserves. The inclination is currently around 7 degrees, and will steadily increase by about 1 degree per annum.

Low transponder receiver sensitivity. GOES is designed to work with a small number of uplink earth stations having large antennas and high transmit power. To saturate the satellite transponder requires more than 1 megawatt EIRP! At the S-Band up-link, using practical solid state power amplifiers, this would require a dish diameter of approximately 10 metres (30 feet).

Limiting, non-linear, transponder transfer characteristic. The transponder was originally used for a single broadband signal, and was not intended for operation with multiple carriers. There is no available information for either the transponder transfer characteristic or intermodulation performance with the type of multiple carrier SCPC service required for PEACESAT. Much of the data used in the design of the Terminals is empirical, based on actual measurements of the satellite.

Unusual transponder uplink frequency. Little in the way of available standard amplifier modules was available with which to construct the earth station HPA.

Each of these problems have been overcome with careful User Terminal system design.

2.1 Transponder Operating Point

The poor receive sensitivity of the satellite results in considerable transponder backoff given the comparatively low EIRP of an economic earth station. The high backoff, in practice about 15 dB, has the benefit of increasing the number of simultaneous carriers which may be supported. Since the transponder is of the hard limiting type, intermodulation distortion is likely to be the principal limitation rather than total power.

However the lost system margin must now be made up on the on the receive side.

In its original role, the satellite signal was designed to be received on a small dish approximately 1.2 metres (4 feet) diameter with a primitive receiver having a relatively high noise figure. By combining a larger dish, needed to generate a reasonable up-link EIRP, with a more sensitive state of the art receiver it has been possible to achieve a 15 dB improvement on the original receive system specification.

3. USER TERMINAL DESIGN

3.1 Dish Antenna

A dish size of 3 metres (10 feet) is about the largest which may be easily installed in remote locations without the use of heavy lifting equipment. It also represents the size above which costs of both dish and support rapidly escalate.

The antenna is of solid aluminium construction for long life and high gain. The dish feed uses a coaxial technology to provide broadband operation covering both the transmit and receive frequencies with common elements.

With a beamwidth of about 2 degrees, it is necessary to track the dish every hour or so to follow the diurnal North-South variation caused by the inclined orbit. The tracking system has been simplified by using a polar mount for the dish, rotated 90 degrees to provide adjustment in the North-South plane. This permits the GOES-3 satellite to be accurately tracked to within better than 1 degree, even when its orbital inclination increases to 15 degrees in around 5 years time. This tracking is implemented with a single axis motorised ball-screw actuator, a ruggedised and uprated version of what's found on many domestic satellite TV dishes.

Both the antenna and mounting have been designed to withstand wind speeds of up to 200 km/h (125 mph) which are encountered at times in exposed tropical islands.

3.2 Receive Low Noise Amplifier

The system has a noise temperature of less than 100 kelvin, including cables, duplexer and dish feed. The low noise amplifier (LNA) is a derivative of a design produced by MAS for another customer to receive low earth orbiting meteorological satellites. It utilises the latest 0.3 micron channel low noise GaAsFETs.

3.3 High Power Amplifier

With an uplink limited system and a given antenna gain, the transmitter power output is the primary variable. The remoteness of many Terminals and restrictions in available power make the use of an efficient and reliable solid state High Power Amplifier (HPA) mandatory. HPAs producing of the order of 50 watts output are commonplace at the Inmarsat L-Band frequencies of 1.6-1.7 GHz. We therefore chose this power level as working figure early in the design process.

A later search for similar amplifiers for the 2 GHz S-Band frequencies drew a complete blank. A number of suppliers offered to design custom amplifiers, but the non-recurring engineering costs quoted were well outside the limited funds available for the PEACESAT project. MAS decided on an in-house development, making use of our past experience in low power S-Band and high power UHF work.

The resulting amplifier design produces more than 50 watts of RF output from a DC input of 28 volts, easily meeting the project requirements. It is protected against infinite load mismatch, and is based on a low thermal resistance construction for maximum reliability.

The amplifier uses two output transistors combined with hybrids to achieve the high power level. The entire three stage amplifier is constructed on a single substrate using a proprietary high permittivity alumina-PTFE material. This combines all the electrical advantages of the brittle alumina microwave substrates with the mechanical advantages of a soft, flexible, substrate.

3.4 Duplexer

In order to combine both transmit and receive signals into the single feed, an S-Band duplexer is required. Again, no available design provided the tight specifications required. Having gone to considerable design effort to achieve the best performance in the transmitter and receiver, a duplexer having minimal insertion loss is required to avoid degrading the overall performance. The duplexer was designed as two bandpass interdigital filters using quarter wavelength coaxial elements. The loss on transmit and receive is less than 0.4 dB.

3.5 Signal Processing

The modulation system used is narrow band FM. The detection bandwidth is 15 kHz. Analog FM was chosen for low complexity and to avoid problems with the non-linear transponder transfer characteristic.

The demodulated signal to noise ratio is about 35 dB and would only just be acceptable for voice, so 2:1 sylaballic companding is applied to the voice audio circuit.

This increases the weighted signal to noise ratio to better than 50 dB and considerably improves on the 'marginally commercial quality' specification in the original PEACESAT Request for Proposals.

For data operation the FM pre-emphasis and companding are turned off. Using V.32 modems with trellis coding a BER of better than 1 in 10^6 at 4800 bits per second and better than 1 in 10^5 at 9600 bits per second is achieved.

4. SYSTEM DESCRIPTION

Figure 1 illustrates the major antenna components of the User Terminal. These are as follows [numbers refer to the diagram]:

> The antenna feed assembly [1], is connected by a low loss coax [2] from the dish [3] to the antenna electronics box [4] mounted on the antenna mounting tube [5].

The cast aluminium waterproof antenna electronics box contains the duplexer, HPA, LNA, up and down converters, power supply regulator, and actuator controller.

> An IF coax cable and control cable [6] link the antenna electronics box and the indoor electronics unit. These two cables are laid underground at the majority of sites.
>
> The actuator [7] tracks the satellite's daily inclined North-South movement. The actuator cable [8] connects to the antenna electronics box.
>
> The antenna mounting tube is concreted into the foundations [9].

Figure 2 shows the layout of the indoor electronics unit. This consists of a rack frame mounted inside a desktop carry box. The frame accepts slide-in modules in two horizontal banks. The modules are as follows:

> The antenna actuator control module [1].
>
> The duplexer module [3] connects the antenna coax to the receiver and transmitter modules. The receive and transmit signals are combined onto the single coax cable, together with the DC power for the antenna electronics box.
>
> The transmitter module [4].
>
> The transmit audio processor module [5] allows selection of the transmitter audio input and the operating channel.
>
> The receive audio processor module [6].
>
> The rack power supply module [7].

5. CONCLUSION

The Ground Terminal described in this paper is just the beginning of the potential capabilities of the GOES PEACESAT satellite system. It will only be when the network is fully commissioned and experience gained with the equipment that further enhancements can be investigated. Some of the exciting possibilities are:

5.1 Small Aperture Receive-Only Terminal

Since the satellite transponder is uplink limited, it would be possible to design a Terminal for receive only operation with a smaller dish antenna, perhaps as little as 4 feet (1.2 metres) diameter. This could be used for one way transmission of educational information to locations where the cost of a full transmit/receive Terminal could not be justified.

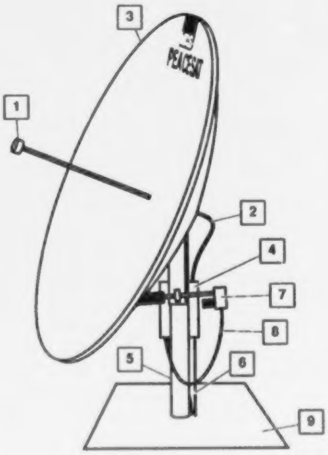
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Figure 1 Major Antenna Components

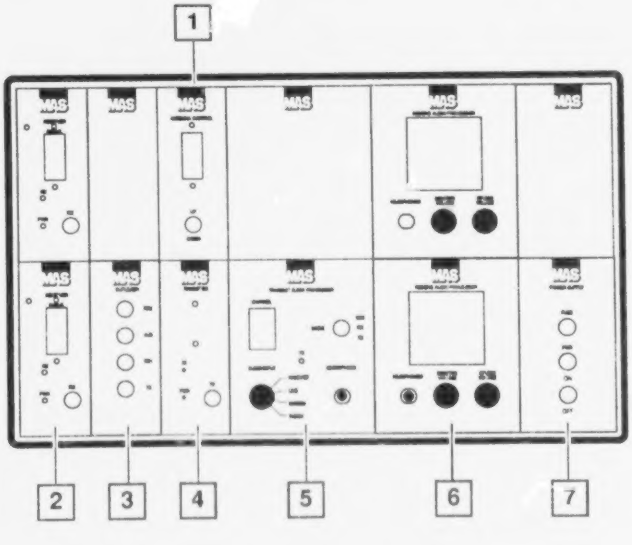
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Figure 2 Indoor Electronics Unit Layout

5.2 Television Transmission

Since the satellite transponder has an 8 MHz wide bandwidth, it is feasible to transmit a narrow deviation FM modulated television through it. To do so would require a up-link Master Terminal with a large dish antenna and high power transmitter. The TV could be received on the existing Terminals with the addition of a broadband demodulator. Provision has already been made in the Terminals to bring out the receive intermediate frequency for such expansion.

5.3 Echo Cancellers

As the price of digital signal processors falls, it will soon be economical to add a full digital echo canceller card to the terminals replacing the existing echo suppressor. This will greatly enhance the full-duplex operation of the Terminal, permitting high quality telephone type operation, and allowing enhanced connection to the Public Switched Telephone Network.

5.4 Automatic Station Control

The addition of a microprocessor controller would permit 24 hour unattended operation of the Terminal for such applications as computer to computer data transmission.

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TRAPS AND PITFALLS IN THE EDI ENVIRONMENT THE LEGAL ISSUES

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Sly and Weigall
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ABSTRACT

Electronic Data Interchange ("EDI") emerged as a developing technology in the early 1970's and will, in time, become the predominant method for business contracting and communication. EDI is unique as a business technology because its primary purpose is to expedite and facilitate binding contractual relationships. Transacting business by EDI is perfectly legal but the uncertain legal effect of the lack of paper raises the important questions as to the enforceability of contracts executed using EDI. This paper discusses how such systems can accomplish the traditional legal goals of paper communication and the desirability of carefully considered pre-implementation agreements.

The concept of the "paperless office" is an attractive one and is theoretically achievable. However, the volume of paper sent from one enterprise to another is currently larger than ever. One reason for this is probably that the technology is new and has not yet been fully accepted, but a more powerful brake on the extensive use of electronic document transmission is the problem of authenticating the contents of those documents if there is a dispute.

EDI has a legal dimension. Companies use EDI to give instructions, make representations upon which others rely, react to instructions from others, account for the exchange of assets and evidence the performance of and compliance with contracts. When companies use EDI to issue and accept purchase orders and transportation orders, they are generally forming contracts intended to be legally enforceable.

A discussion of the legality of EDI invariably questions how EDI systems accomplish the traditional legal goals of paper communication. These are concerned with:

- the display of proof that information is authentic;
- the communication of trade terms and conditions;
- the permanent storage of information; and
- the satisfaction of laws which require certain legal information to be "written" and "signed".

More subtle questions emerge on closer examination:

- how should trading partners and intermediary networks divide among themselves the risks for errors?
- how will Government record retention and control requirements be interpreted for electronic communication?
- what replaces the visible audit trail?
- should the law be modified to clarify its application to EDI?

Other issues requiring examination are:

- privacy;
- confidentiality;
- negligence; and
- protection of intellectual property.

The development of solutions to EDI's legal issues require first, recognition of the issues and second, careful legal and business analysis. Legal considerations do not present any inherent road blocks to EDI implementation but managers should have a working knowledge of the relevant law to enable them to recognise when it is prudent to seek advice. There are, as yet, no well tested models for handling the legal issues so the guidelines must be developed practically and realistically.

EDI has been around for quite some time and so far, to my knowledge, no law suits have arisen in Australia or elsewhere. This may be because implementation requires considerable advance coordination and testing between trading partners and the very nature of EDI may make misunderstandings less common.

It may be because EDI reduces the number of keyboard data entry errors. It is more likely, however, that because, to date, electronic based business relationships have been between larger corporations or a large corporation and its suppliers, the trading relationship is more important than any legal haggling which might occur over an interpretation of an individual contract. As EDI becomes more popular, however and EDI is used for larger, less routine transactions than at present, it is quite likely that disputes will arise. To guard against this many trading entities are developing agreements dividing responsibilities between partners so that any disputes can be resolved quickly and cheaply. To date there is no universal standard agreement, although the EDI Associations of Canada, New Zealand, South Africa, Australia and the UK have produced a variety of models, as has the American Bar Association in the U.S.

TRADING PARTNER AGREEMENTS

There is no simple rule on how extensive a trading agreement should be. For many businesses a simple short letter of agreement will be appropriate - for others more detailed provisions are desirable. Every issue will have several alternatives and the risk of building so many safeguards into a system that it is unusable can be as great as the risk of simply ignoring important issues. However, it should be sufficiently detailed to be totally clear.

Agreements, after all, are referred to not only in litigation; they also provide day-to-day guidance on what the partners expect of one another and provide a framework for private settlement if a mistake happens.

Written agreements are especially important in long term relationships overseen by a succession of different managers. They have the advantage of providing guidelines to those who are not around when previous "hand shake" agreements were struck.

To date no law exists in Australia which specifically prescribes how EDI is to be conducted between commercial trading partners. Nonetheless it does exist in a well developed legal environment. There are substantive legal frameworks which control the underlying transactions facilitated by EDI but because of the rapid change in technology these frameworks, when enshrined in statutes, sometimes clash with reality.

Internationally some customary law is developing. In 1987 the International Chamber of Commerce developed a set of voluntary guidelines for international transactions entitled "The Uniform Rules of Conduct for Interchange of Trade Data by Teletransmission" (UN-CID) It was intended as an interim solution to the legal shortcomings in EDI and seeks to define "an acceptable level of professional behaviour" and to "secure a common approach". UN-CID identifies some problem areas as:

- risks in transmission;
- acknowledgements;
- return receipts;
- security;
- data logging; and
- storage.

These rules are useful as general principles but they are not comprehensive and are inadequate for substantive legal purposes.

A former chairman of the ECE Working Party on Trade Facilitation has said "UN-CID is . . . a bridging operation pending changes in the law or the formulation of laws specifically dealing with EDI . . . let us recall the need for overhaul and updating of national legal requirements . . . users and industry groups and their national facilitation organisations must take the initiative and move their respective governments to undertake the necessary changes."

There is also a body of general contract law dealing with the precursors of EDI in information technology such as telegraph and telex.

Some statutes require communication to be "written" or "signed" to be legally effective. These requirements were originally enacted to preclude oral communication, not to exclude electronic communication, and the

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flexibility of commercial law will generally ensure that the writing and signing requirements will not be a substantial block to EDI. Nonetheless, if there is a strict requirement for some manual communication the use of trading partner agreements can head off any significant problems.

Before agreements are drafted some general recommendations might be made to companies implementing EDI for valuable transactions. Ben Wright, a Texan attorney who has focused his attention on the legalities of EDI over the last three or four years has devised a check list:

- make system reliability and security a priority;
- ensure the communications channel has the necessary level of checks and controls; and
- keep an appropriately detailed audit trail, consisting of a mixture of acknowledgements, tracking numbers, audit logs and network reports;
- systematically compare and reconcile audit trail information with messages;
- follow up on inconsistencies and keep a record of reconciliation;
- devise a trustworthy system for keeping an unmodified log of data sent and received;
- periodically have auditors review the system for weaknesses in reliability and control;
- take all this into consideration upfront, when designing and developing the system.

System providers will have a natural concern for their own liabilities and may tend to draft agreements which attempt to protect their own systems but not necessarily those of the customers. There must be adequate minimum standards for network access, for responsibility for accuracy and delivery and for tracing the path of communication. The respective responsibilities between electronic service providers and customers must be resolved, but in the meantime networks could include provisions in the standard customer agreement regulating certain contractual issues unless the parties specifically agree otherwise. Trading partners should refer to the standard terms in their electronic communications, conditioning assent to be bound upon acceptance of those terms. Trading partners might place their pre-authorisation agreement on line with an electronic messaging and information system, or consent could be indicated in advance through a service offered by a value added network or on an electronic database.

A trading agreement should, among other things, stipulate which symbols will be deemed to be signatures; when the symbol as signature is limited in its authority and when the parties must retrieve messages from E-Mail boxes for the document to be deemed effectively received. It should establish, with precision, how terms are to be offered, accepted, rejected and modified.

The role of functional and application acknowledgements should be clarified. Will an application acknowledgement be the only communication that can legally accept an order or a bill? Or will the return of a functional acknowledgement, followed by so many days during which no objection to, say, the order or bill is communicated, constitute acceptance? Or is an acknowledgement necessary at all?

The agreement should also describe each party's responsibilities for performing auditing and checking routines on messages received.. The reconciliation and checking of messages for errors and compliance with EDI standards is critical. Financial auditors sometimes recommend that trading partners enter into specific agreements on error checking to provide an extra measure of accounting control. What happens, however, if a party fails to detect an error? To what extent is it liable to its trading partner for any resulting damages? The agreement can help to resolve this issue.

The counterpart to the error-checking clause is the security and control clause. If the recipient takes any responsibility for checking for errors and fraud, it will want assurance that the sender does its part to prevent them. This may be handled directly by holding the sender a standard of care and by requiring the sender to institute security and control measures: each party will implement reasonable security measures to protect against the use of its facilities, information, computers and third party network access devices and passwords to transmit unauthorised or unintended messages, and will regularly test and re-evaluate the effectiveness of such measures.

If a point to point connection is used, the agreement should set out the authority which outside callers will have when they link into a given computer.

If there are clearly expressed rules on the scope of authority it may be easier to prosecute any computer crimes.

The elements recommended by UN-CID to be considered when formulating a trading partner agreement are as follow:

1. There is always a risk that something may go wrong - who should carry that risk? Should each party carry its own or would it seem possible to link risk to insurance or to a network operator?

2. If damage is caused by a party failing to observe the rules, what should be the consequences? This is partly a question of limitation of liability. It also has a bearing on the situation of third parties.

3. Should the rules on risk and liability be covered by rules on insurance?

4. Should there be rules on timing i.e. the time in which the receivers should process the data etc?

5. Should there be rules on secrecy or other rules regarding the substance of the data exchanged?

6. Should there be rules of a professional nature such as the rules applicable to the banking and securities industries?

7. Should there be rules on encryption or other security measures?

8. Should there be rules on "signature"?

It would also seem important to have rules on applicable law and provisions for dispute resolution.

It would be prudent for trading partners to agree that their EDI communications will be kept confidential. They should further agree to cause their third party providers to preserve confidentiality.

The relationship between an EDI user and its third party network is normally governed by a services contract. Users should consider the terms carefully before signing the standard agreements furnished, since they will become dependent upon the network and need assurance of service and security.

The agreement should describe in detail the services to be rendered and should cover the control, ownership, confidentiality and security of interchanged data as well as statistical information about the data. Audit concerns may require that the customer have access to certain network reports and documentation. Networks usually insist on strictly limiting their liability for errors but users have reason to negotiate strongly for networks to assume a greater liability.

SECURITY

There are two aspects to security. The first concerns prevention of fraud and crime; the second protects information privacy. The first aspect seeks to prevent unauthorized access and to ensure that staff structures are organised in such a way to reduce internal frauds. It also raises policy issues such as whether a financial institution should be made to bear losses resulting from the failure of security on the assumption that the cost of insurance may be spread. The second aspect relates to data protection and in this connection it should be asked not only if data protection principles have been observed, but also whether the system itself is sufficiently secure. Severe legal and commercial consequences arise in the event of penetration of databases by unauthorised persons.

It should probably be noted that in Australia, there is no generally recognised common law right to privacy. End to end security provisions are essential.

The common law, however, does recognise a right to the "confidentiality" of information which:

(1) has a certain hard-to-define quality of "confidence"; and

(2) has been imparted to another in circumstances which indicate that the confidant is to keep the information confidential. Certain relationships, such as

the relationship between a banker, lawyer or accountant and his or her client or customer, have been recognised as relationships which infer confidentiality. The imparting of trade secrets to others in circumstances where it is clear that the information is to remain confidential is another well recognised example of circumstances which raise a legal duty of confidentiality.

Given the inherent complexity of the law of confidentiality, and the added uncertainties caused by variations in the law from State to State, serious consideration should probably be given to codification of this area of the law so that it is uniform throughout Australia. Whether this is done by Commonwealth legislation or by uniform State legislation is a question of constitutional law and of politics.

The Commonwealth Privacy Act 1988 provides limited protection for data and information. It contains 11 Information Privacy Principles (IPP's), for the breach of which by any Commonwealth Government agency an individual is able to seek recourse. This legislation was intended to cover some of the deficiencies in the common law, which, as it currently stands, offers several potential causes of action for aggrieved parties, all of which have severe limitations. However, the Act provides solace only for individuals and is restricted to Commonwealth agencies so is of little application to general business activities and the security of data bases remains largely unprotected.

(Unlike the situation in Europe, the U.S. has also, to date, adapted a sectoral approach in which privacy protection is targeted at particular parts of the public and private sectors.)

Other legislation has recently been introduced to provide criminal sanctions against certain offences against privacy of data. The Commonwealth Crimes Legislation Amendment Bill 1989 creates a series of offences involving either deliberate unauthorized access to data or more serious offences where the offender either gains that access with intent to defraud or knows, or ought reasonably to know, that the data is of a specified type which is considered particularly sensitive. The amendments do not seek to cover computer crime generally since most situations can be more appropriately dealt with by State laws and law enforcement authorities. The provisions in this legislation are also directed to the protection of Commonwealth computers and data and Commonwealth facilities.

NEGLIGENCE

How can users and third parties avoid an action in negligence?

Users rely on their partners' ability to conduct EDI competently. Incompetence can be costly. EDI is, for example, implemented as an element of "just-in-time" manufacturing and a supplier's blunders could tie up its customer's operation for days.

Prior agreements would again seem to offer some protection. An agreement might set standards for the creation and retention of EDI records, including information on message content, control information, network audit trail and so on. Article 10 of the UN-CID rules requires retention of trade data logs - complete, historical records of interchanged data. The purpose of record standards is to ensure there is sufficient, credible evidence to refer to if a question or negligence arises.

Some users, however, may not welcome being held to standards of care, proficiency and recordkeeping. They may be new to EDI, or may believe they would more likely be liable to their trading partner for an error than vice versa. They may prefer a low standard of care, or even a limitation or disclaimer of liability for errors. Issues of negotiation, then, are the levels of care expected and the allocation of liability for any loss, particularly consequential damages, caused by errors and incompetence.

INTERNATIONAL LAW

Another legal issue relevant to the use of EDI systems is the international tort. It is easy to postulate a negligence action arising domestically within an EDI system at any one of the levels of participation. Problems will arise in any communication system when messages are lost or misdirected, late in arriving or garbled. Ownership, control and access rights, as well as the liability for erroneous or failed transmissions remain unsettled.

Service providers and others will be subject to general legal liability principles but the situation is complicated in the international situation by the difficult question of choice of law.

Three main connecting factors have been used by various legal systems to determine which law should govern in an international tort situation.

(i) The law of the forum in which the case is brought;

(ii) The lex loci delicti (The law of the place where the tort occurred); and

(iii) The "proper law" of the tort, or a variation on this concept (which is defined differently in English and American law.)

In the current legal situation a claim for damages could be differently decided simply because of the different connecting factors in the forum and which is selected. Furthermore if the forum is in Australia or USA the court itself will decide which legal system should apply and it is difficult to predict in advance which of the competing systems might be chosen.

In time maybe a private international law Convention will be drafted providing uniform connecting factors to govern liability in EDI and similar uses of technology. In the meantime any trading partner agreement should indicate which state law will apply. This will add more certainty to the legal relationship.

Electronic messaging systems (EMS) electronic data interchange (EDI) and electronic funds transfer (EFT) are changing the way businesses negotiate and enter into contracts. These changes require a re-examination of fundamental contract principles. They also raise issues of control, ownership and liability and require close examination and reassessment of the rules of government, industry and standards organisation. Until these issues are resolved businesses using electronic systems may continue to face unacceptable risks that their transactions may be unenforceable. Unless legal solutions can be achieved the growth and development of the industry and legitimate business expectations may be hindered. This is of immediate concern to the economy since it has been estimated that by 1992, 40 percent of all businesses in Australia will be using EDI.

CONTRACT

It is often extremely important to determine exactly when a contract or agreement has been made. Detailed rules are applied which distinguish between instantaneous communications and delayed communications.

Electronic messaging systems, including EDI, combine features of both instantaneous and delayed communications, often concurrently using several distinct communications technologies. Technical factors will determine when a message reaches the recipient. These factors are not necessarily subject to the control of the originator. A continuum of communications options is evolving; options which may make it difficult to distinguish between instantaneous and delayed communications. Perhaps a more useful distinction is to distinguish between "conversation-type" communications, (the inter-active mode) and "message-type" communications. The rule presently applied to "instantaneous" communications could probably be applied to any communications which involve the ability to interrupt, ask questions etc., before a message is completed. For other communications, it may be more appropriate to apply the so-called Postal Rule. Offers and acceptances would then bind the sender upon dispatch and until a reasonable time has elapsed for a response to be received. A revocation, however, would not have any legal effect until receipt.

EDI standards makers have conspicuously disclaimed responsibility for deciding whether or when the interchange of data forms a contract. In the U.S. the EDI Associations Programming Guide states:

> "The legality of EDI data as binding contracts is left to the marketplace and negotiation between individual buyers and sellers, shippers and carriers, payers and payees."

Several factors will influence any presumptions that communications are received and the appropriate application of the Postal Rule. These include:

* the reliability of the system;

* the power to recall messages;

* the date and time stamping of electronic mail;

* the date and place that returns receipts are generated; and

* methods and availability of mail forwarding.

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A functional question is one of control and ownership of electronic boxes. Delivery may be defined as the act of placing an object within the actual or constructive possession or control of another. The question that arises is whether there is sufficient actual or constructive possession or control over an E-Mail box by the recipient to constitute delivery.

Because of its physical characteristics, the traditional paper document is accepted as evidence. It is durable, and changes or additions will normally be clearly visible. The electronic document is significantly different.

However, the paper and the data communication links are only media for carrying information, and it is certainly possible to establish techniques which give electronic data interchange characteristics that make it equal or superior to paper, not only as carrier of information, but also as regards the evidential functions.

EVIDENCE

Records of EDI data may be considered "hearsay" under a technical concept of evidence law, (although the point is debatable) If so, the records may be not be admissible unless they were created as a routine function of business. However, since that is the way EDI is usually employed the hearsay issue should ordinarily not impair admissibility of EDI records prepared in a routine, trustworthy fashion.

Another technicality - the "best evidence rule" - may also question the admissibility of an EDI record. Generally, the rule requires that, where possible, only the "original" of a writing go into evidence. There may be confusion about what is an original of a computer message. However, the rule should not prevent the admission of trustworthy EDI records. When computer records were first considered many years ago the courts puzzled over the definition of "original" but have rarely used the best evidence rule to exclude reliable computer evidence since the rule´s purpose is simply to admit the most reliable evidence available.

In general, computer output is acceptable as court evidence only when supported by technical witnesses who can testify to system reliability, the observance of good security practices, and so forth. This would apply where an electronic mail message was produced as evidence of contractual relations, but its timing, sending or receipt was contested, or there was, for example, an issue about responsibility for non arrival of a message. An E-Mail system may provide proofs concerning the delivery of a message, and the identity of the sender and recipient, based on public-key encryption systems. Such proofs are limited, however, by the mails trustworthiness, on which the courts would need persuasion.

What constitutes "reliable computer equipment and techniques" for creating EDI records?. The significance of this question goes beyond mere admissibility of evidence. Once submitted, evidence is worthless unless also credible to the judge.

There are techniques which can enhance the credibility of EDI records:

- third parties, such as value added networks can keep records of messages. For instance, the SWIFT system for international fund transfers keeps an inventory of data. Networks could archive audit trail or message content data for legal and auditing purposes;
- each user can keep a data log i.e. a reliable, logical compilation of message content, electronic signatures and audit and control information (the UN-CID rules require use of a data log);
- each user can keep a separate data summary or audit log of transmitted data in hard copy;
- an audit trail can be maintained to evidence what happened to date between receipt and final archive;
- archives can be created and stored under a rigid routine, using non-erasable media or, alternatively, protected by appropriate controls such as lock and key and the segregation of duties for employees charged with record keeping responsibility; and
- cryptography can curb data fabrication.

EDI, if properly implemented, can answer the fundamental legal objections which may be raised against it. There are, however, few absolutes in determining precisely which controls are necessary in any given system. This judgment must be made by informed professionals within individual companies and individual industries.

INTELLECTUAL PROPERTY

The last legal issue infringing the EDI environment involves the protection of intellectual property. The high speed of development in sophisticated electronics has provided a strong challenge to the legal systems expected to protect the intellectual property. Copyright is the generally favoured mode for protecting computer programmes throughout the world and in Australia the Copyright Amendment Act 1984 give programmes in both source and object code the express status of a "literary work". These amendments were intended to cover, not only conventional computers, but also devices with some programmed computing ability. It may well be that this legislation will require further amendment if the definition is not effective against the rapid development of technology. In any case, whether the copyright model is appropriate for programme protection is questionable. This area of law has been further confused by the recent decision of *Auto Desk* v *Dyason*, the decision in which implies that the 1984 amendments prohibit the reverse engineering of computer programmes, making those amendments sit very uneasily with the legislative approach now taken in the Copyright Amendment Act 1989. No doubt these anomalies will be addressed by the Copyright Law Review Committee in its current reference on the 1984 amendments.

CONCLUSION

In summary, some laws need revision or clarification to be consistent with EDI and although in many cases EDI can be safely used before the laws are changed, the industry should examine those which appear to pose problems and, where appropriate, strenuously advocate change. In the meantime, users and providers, in consultation with their legal advisers, will be well advised to develop a strategy successfully and efficiently to negotiate timely and appropriate trading partner agreements.

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Private Trade Data Networks: A Commercial Tapestry in Progress(*)

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The electronic movement of data for domestic and international trade purposes has greatly increased. This paper examines the legal and practical aspects of electronic data interchange in order to understand their significant impact on trade processes.

I. Overview.

Domestic and international trade has become increasingly dependent upon the effective and efficient electronic exchange of business information. Historically, the oil, shipping, financial service industries, among others, together with the ongoing affairs of multinational corporations, first developed the compelling need to be electronically linked in order to assure the proper execution of their respective functions in commerce. Now, with the broader availability of continually advancing technologies, the interdependence of commerce and successful computer communication has been established as a critical component in the evolution of global trade policies.(1)

The electronic movement of trade data is no different than any other area of commerce. Those able to achieve economies of scale in operations and offer those economies to others, and able to add value to the basic services of data communication, have the capability of establishing a proper and long-lasting role in commerce. Such service providers have, in fact, emerged and are proving to play a critical role in facilitating the increased level of trading in goods and other services. Their commercial activity in support of other areas of trade is both direct, in providing the actual communication services, and indirect, in providing the educational materials and ancillary software products required in order to prepare companies to engage in electronic commerce. In addition, commercial necessities (and opportunities) are pressing service providers to develop and enhance their capabilities to exchange the trade data messages of their respective customers. As these electrical interconnections begin to be woven together, a sector of commerce is defining itself as being something slightly different than either what has come before it or what is concurrently taking form within other venues.

Although GATT and additional international organizations are considering the regulatory and other policy factors relating to trade in services (including telecommunication and related services), few have begun to consider, particularly from a legal perspective, the practical considerations confronting this emerging service industry. The following materials are a modest attempt to make a contribution toward further inquiry in that direction, with the undisguised purpose in mind of attempting to facilitate, and encourage, the vitality and growth of this sector of commerce and the continued advancement of electronic commercial practices domestically and internationally.

Two objectives are in mind:

- To identify and define the types of service providers operating with respect to private trade data communications, the nature of the services provided, and the interaction of those services with the underlying commercial transactions to which the communications relate.

- To consider the practical features of interconnect activities between service providers, which are essential to assuring the continued free flow of private trade data communication, and the emerging commercial and contractual issues.

II. The Function of Electronic Data Interchange in International Commerce.

As the world considers the development of mutually acceptable strategies to enhance international trade, the objective of effective computer communication has become apparent. Properly implemented, the technologies which permit business information to be electronically exchanged between trading partners (and others in the streams of commerce) will enhance the tradeability of other goods and other services.

Though private multinational corporations and financial institutions, in particular, have maintained for some time the capability to electronically transmit business information, their activities were highly proprietary in nature. The communication systems and functions were designed only to facilitate the particular needs and objectives of those in control of the systems.

For example, within a corporation, there was little incentive, in developing the initial strategies for facilitating electronic data transfers from one branch office to another office, to contemplate also having the flexibility to effect such transactions with others outside the corporation. Similarly, in constructing the closed network within the international banking industry operated by the Society for the Worldwide Interbank Financial Telecommunications (SWIFT), there was likely no strategic value to designing the network to be accessible to, or to support communication between, the participants' respective customers. Within other industries, there were early comparable networks developed to facilitate electronic trade data exchange; in those industries, as well, specific needs were addressed with specific solutions without regard to the broader potential of the technology. At best, in any such case, one could argue that, even if the capabilities of the technology to eventually support such trade data communication activities were considered, the economic and technical challenges outweighed the potential benefits which could then be foreseen.

Yet, the economic and commercial benefits of the early trade data communication systems developed an irresistible appeal. The continued expansion of these systems has provoked the beginning of a fundamental transformation in the manner in which the information streams of commerce function. Electronic data interchange (EDI) is the communication technology which has emerged as the essential tool of electronic trade. The role of EDI in future international trade development cannot be underestimated; one commentator has observed that the "inability to access such interchanges will be the equivalent of an absolute barrier to international trade."(2) For developing countries, EDI may be perceived as creating equality of trade opportunity.(3)

A. The Basics of EDI.

Technically stated, EDI is the transmission, in a standard syntax, of unambiguous information between computers. EDI is being integrated into business at an accelerating rate, and is expected to become the predominant method of business communication in the years ahead. Principally, EDI may be used to transmit files and records of information, and to facilitate the exchange of the electronic equivalents of conventional paper documents (such as purchase orders, invoices, shipping notices and remittance advices). In that manner, EDI realizes the practical benefits of reducing paper handling and storage requirements, data entry error (as well as the need for repeated entry of comparable data) and administrative and processing expenses.(4)

EDI communications are structured around either proprietary or public standards, which define in detail the format and structure of the data, around which related software products must be constructed. The standards may include data dictionaries, segment dictionaries and transmission controls, together with certain codes or symbols for which indexes are developed, all of which facilitate communication. The codes are generally substantive, reducing to a few letters or symbols a more complicated trade term, message or instruction. This permits the data to be more readily processed and evaluated without human intervention. Thus, with standards, the traditional manner in which the information is communicated is altered; the information is generally transmitted as data (not text), is in a prescribed order and "normal" words are condensed into symbols or codes with pre-defined meanings.

Generally, each set of standards is unique; communications formatted to one standard cannot be processed by a receiver equipped to accommodate communications formatted to a different standard. As a result, there is a significant effort underway to develop public standards sufficiently adequate in scope and flexibility to support the needs of those previously committed to proprietary or industry-specific standards. Until then, translation software products are effective to reformat data elements and thereby allow communication despite the adoption of different standards.(5)

The most notable public standards are:

a. American National Standards Institute, Accredited Standards Committee X.12 (ASC X.12), which is a multi-industry, voluntary effort in the United States to develop transaction sets (essentially electronic "documents") for many commercial communications.

b. UN/EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport), under development by the United Nations Economic Commission for Europe Working Party on Facilitation of International Trade Procedures (the "UN/ECE Working Party"), which is a multi-national effort to develop similar types of message standards, while reconciling technological, cultural and commercial variances.

B. EDI's Impact on Trade Processes.

EDI communication technologies have the capacity, and are beginning, to also alter the manner in which the underlying trade transactions occur:

1. The technologies facilitate instantaneous communication. Written media, the traditional channels of commercial dialogue, generally involve delays between the legally significant events of transmission, delivery and receipt. Utilizing telecommunication capabilities, EDI messages move more quickly. As a result, contracting practices relating to the duration of offer periods, acceptance deadlines and similar procedures, and the assumptions of how deals are finalized around those techniques, are subject to alteration. Particularly with commodities subject to dramatic price adjustments within sensitive markets, EDI helps assure that one will be comparing "apples to apples" in the decisionmaking process.

2. The technologies permit multiple, simultaneous transmissions and receipts. Utilizing a machine's capability to copy the same message and concurrently send it with EDI in different directions, a lessee, by example, may simultaneously extend offers to receive

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bids on a proposed package of equipment to different lessors located in different locations, and demand responsive bids in dramatically shorter time periods.

3. EDI works effectively, irrespective of the distance between trading partners and, with increasing frequency, irrespective of cultural, language or other traditional trade barriers. Accordingly, diverse social and politial interests, trade procedures and technological levels can be and are represented in the process of achieving consensus on each standard with regard to data elements, codes and syntax rules.

4. EDI results in more automated processing of the business information which is communicated. In order for such automated processing to occur, conventional trade terms must be standardized into certain codes, symbols or other abbreviations which will be transparent to software applications (irrespective of the identity of the trading partners, or the underlying commodities involved).

The ability of EDI to effect these types of changes will also depend on the success of trading partners to achieve mutual agreement on a variety of technical and commercial issues as a predicate to commencing EDI communications. These agreements may be informal or formal. Domestically and internationally, there is movement toward greater use of definitive written trading partner agreements, comparable to the ABA Model Agreement dealing specifically with these commercial and technical issues. One significant issue to be considered relates to the selection and use of service providers; defining their role in the exchange of private trade data between trading partners will likely have substantive implications on the manner in which underlying commercial transactions will occur.

III. The Functions of Service Providers.

A. An Emerging Infra-structure.

Though the direct transmission and receipt of EDI communications between trading partners occurs, the much more common practice, domestically and internationally, is to communicate through a service provider ("Providers"). One of the significant reasons for this practice, other than simply sharing in the benefits of economies of scale (i.e. the hardware, software and administrative costs of EDI communications), is to obtain the additional value-added services which such Providers make available. Although trading partners often utilize the same Provider, it is also increasingly common for each trading partner to have its own Provider, which must, in turn, exchange the EDI messages between themselves for the benefit of their respective customers.

The result of participation by Providers in EDI communications is the development of a communication infra-structure, effectively introducing itself between the end-users of telecommunication (or satellite) facilities and the existing facilities. Providers, in adding value, render themselves distinguishable from the telecommunication (or satellite) operators and, therefore, of independent commercial value.

There is another infra-structure which the emerging network of EDI Providers represents, though slightly more difficult to isolate. In entering into the communication chain between those in commerce, Providers also become indirect participants in the underlying transactions. With respect to the data as a commodity, Providers become indispensable to the formation of contracts and their execution. Their role may best be demonstrated by analogy.

For example, a buyer and seller enter into a contract for the sale of goods, which requires the delivery of the goods by common carrier. The common carrier becomes a participant in the underlying commercial transaction of sale by virtue of its responsibility to transport and deliver the goods in accordance with the commercial terms mutually agreed upon by the parties. Without the common carrier, there is no performance.

With EDI, the communication of the trade data between the parties begins to occur in a comparable manner. That is, the Provider becomes a participant in the commercial transaction, by serving as the interchange mechanism for purchase orders and invoices, shipping notices, status requests, change orders and remittances advices. As commerce becomes reliant upon electronic communication, so will the ability of the underlying transactions to be completed hinge upon the effectiveness and performance by Providers. Thus, the Providers evolve toward the role of an essential interface between many of the traditional relationships from which commerce is structured: buyer-seller; customer-banker; consignor-consignee; manufacturer-distributor-retailer.

Initially, it is perhaps easy to dismiss the analogy. Those in commerce readily have available in the current environment paper-based alternatives which allow them to continue to function should electronic linkages be inoperable. However, as commerce continues to conform itself to the changes which EDI invites in their commercial practices, the option of communicating on paper becomes less and less viable as a means of continuing business transactions to completion. Changed expectations of timing and performance render the option impractical. The implications of these evolving Provider infra-structures are considered, at least in part, by the remaining materials.

B. Types of Providers/Types of Services.

Although many EDI users may have the economic capability to develop their own network facilities, Providers have been successful in achieving economies of scale that make their services an attractive alternative to internal capital investments by those users. Almost without exception, the relationship between users and Providers are formalized by written service agreements. Pursuant to these agreements, Providers function as electronic mail processing systems, and maintain electronic "mailboxes" from which communications between trading partners may be conducted. EDI messages may be received, stored and re-transmitted at a later date; or may be held in a "mailbox". Additional services are available.

The following is an attempt at identifying, and perhaps categorizing, the type of Providers currently in operation:

1. Closed User Group Networks. Representing the early types of networks which evolved, these types of networks generally have no independent Provider involved; although a separate operations facility may be necessary to the operation, the users have sufficiently defined their communication functions and operations to, in effect, function as if no independent Provider exists. Some examples:

a. Transnational Corporations. The use of EDI (or comparable messaging systems) to coordinate raw material deliveries, production schedules, inventory shipment, distribution and financial services has proved to be a competitive necessity. Companies such as General Electric, E.I. DuPont & de Nemours & Co. maintain highly secure, reliable electronic networks.

b. SWIFT (Society for Worldwide Interbank Financial Telecommunications). SWIFT manages well over one million messages on a daily basis with regard to electronic funds transfers. Such communications generally occur pursuant to proprietary standards in place.

c. SITA. The airline industry reservation exchange system operates on an international basis, serving, a half-decade ago more than twelve thousand offices in 800 cities in 54 countries.(6)

2. Open Trade Data Networks.

a. Private Subscriber Networks.

(1) Description of Providers.

(a) Independent networks. With few exceptions, Providers to date have been subsidiaries or divisions of larger businesses (or, in at least one notable case, a joint venture of several banks). In addition, many of the Providers have been successful in getting started either by using excess capacity within existing computer networks, or by expanding proprietary networks to support independent trade data communication activity (e.g., Sears Communication Services). A recent EDI sourcebook contained, however, listings of less than 15 Providers within the United States.

(b) Telecommunication-limited network. AT&T has entered this sector of commerce as a Provider, following Judge Greene's 1989 order ending the ban on their participation in electronic value-added services.

(c) Satellite Alternative Networks. The territorial and logistical limitations of current telecommunication systems may be out-bounded by the capabilities of satellite technology. Utilizing very small aperture terminal networks (VSAT) and direct satellite networking, K-Mart has established a direct private communications network connecting over 2,000 stores.

(d) Intermediate Providers. In addition to Providers linked contractually with subscribers, there are additional Providers with no direct contracts with users; their contracts are with the other Providers. These intermediate data transmission networks provide no added value to subscribers, but assist other Providers by aggregating in managing high volumes of data transmissions. In considering the infra-structures discussed above, their role further complicates applicable commercial issues requiring attention.

(2) Description of Value-Added Services. The typical Provider, as noted earlier, offers its services on a subscription basis. Basic communication services are generally performed for a basic flat rate, with additional per item charges based upon the number of documents, and the length. In addition, services other than the basic communication activities are performed for additional fees. The availability of these services is mutually beneficial: many of the services open up new trading partners with which to conduct business through EDI, which business is transmitted through the Provider's facilities (generating additional income).

b. Network Interconnect Arrangements. In order to connect communications between subscribers with different Providers, Providers must "mail" EDI messages between themselves. It is in this interconnect process that the private trade data network infrastructure finds its momentum. Four types of interconnect arrangements predominate: (1) direct agreements between Providers; (2) arrangements with local telecommunication carriers; (3) arrangements between Providers and internal corporate "Providers"; (4) indirect arrangements with other trading partners.

IV. Commercial Issues of Interconnects.

A. The Absence of a Difference: The Telecommunication Analogy.

Within the regulated environment of telecommunications, both the FCC and state authorities have determined it appropriate to

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define, and retain approval of, the terms and conditions by which each participant in the telecommunication chain connects to another. These contracts, whether they are between a cellular company and a local carrier, between two local carriers or between local and interstate carriers, have elements common to the commercial and contractual issues inherent to establishing a Provider interconnect arrangement. Those issues are (a) technical, with respect to establishing the interconnect and maintaining reliability as to the operations, (b) economic, with respect to cost of operation, shared expenses or billing through to customers particular services or costs and (c) contractual, with respect to defining communication obligations, notices with regard to non-performance and allocating risks and responsibilities inherent to EDI activity. In considering possible contractual and commercial issues between Providers, the existing telecommunication infrastructure (and the required agreements between participating entities) may provide a useful starting point.

B. Interconnect Agreements.

1. General strategy. In establishing Provider interconnect arrangements, the strategies reflected in telecommunication agreements within the United States are perhaps a better starting point, as compared to trading partner agreements, for analyzing the commercial issues of interconnects. In the process of interchanging transaction sets or messages, the actual data content (i.e., purchase order, documentary credit, payment instructions) is irrelevant; indeed, interconnect arrangements would not be productive if such differences made a difference. Therefore, one might expect Provider interconnect agreements to be substantially bilateral, treating each Provider on a level playing field, with the risks and responsibilities equally allocated.

2. Specific business issues. To date, most interconnect arrangements are substantially informal, with few written agreements. Those agreements which do exist are substantially comparable, and brief (reputedly having their origin from a single back side of an envelope). Using the resources available as analogies, agreements responding to interconnect Provider issues might include the following:

(a) What scheduling issues exist in establishing interconnect capabilities? What testing or other verification procedures must first be completed? What arrangements are to be made to assure each Provider will proceed forward diligently in establishing the interconnect?

(b) What specifications must be defined to assure the ability to effectively and reliably communicate? What levels of access must be permitted between Providers? What security procedures must be implemented? To what extent are those procedures comparable to those required of subscribers?

(c) What uses, or limitations, exist as to the data to be transmitted? What access, if any, may one Provider have to the value-added functions or services of the other Provider?

(d) What transmission and receipt rules and protocols will be established? How will interrupted transmissions be addressed? What priorities will be given to non-Provider generated messages?

(e) What restrictions might exist on contact between the respective subscribers of each Provider? What information must Providers share to permit messages to be identified and properly routed? What arrangements on confidentiality will exist with respect to such information?

(f) What liabilities, or limitations, between Providers will be contractually established? What exclusions of damages may apply? What is the applicable governing law?

V. Some Legal Factors.

A. Data Disclosure.

The process of data communication inherently involves (a) creating a copy at each end (and at each intermediate stage) of an interchange and (b) transmitting that data across communication systems with varying levels of security. As a consequence, the possibilities exist for information being electronically communicated by Providers to be intercepted, copied further than contemplated or otherwise diverted from the intended purpose. In addition, Providers routinely retain records of communications which they handle, either as a value-added service or as a means of internal audit to assure the ability to respond to any inquiries regarding lost or corrupted data. From this matrix of realities, a number of interactions arise with existing principles of law relating to disclosure. The following exemplify the potential for further inquiry.

1. Content of data. Liability can attach to the communication of information, based on the content and perhaps the intent of the party which communicates the information. Considering that Providers not only transmit private trade data but may also construct databases which are re-sold for commercial value, note the following potential issues: (a) Erroneous data; (b) Defamatory or slanderous content; (c) Private data and confidentiality; (d) Contractual liability disclaimers by providers; (e) Choice of law.

2. Obligations to disclose Stored Data.

a. Contracting practices. Many EDI users impose contractual obligations upon Providers to keep all private trade data confidential and otherwise to not make certain disclosures (with customary exceptions regarding court orders or otherwise generally public information). These provisions only work so far, and, for example, often do not apply where a Provider has received data through an interconnect which is itself not generated by the subscriber to such Provider. Unless carefully drafted, such confidentiality clauses rarely apply to data moving in all directions. Whether such contractual obligations will, in fact, be honored by a court is a further consideration.

b. Multi-national restrictions. Providers which may maintain data records of EDI activity in different jurisdictions may be subject to different national laws regarding disclosure.

3. International Principles of Confidentiality. The objective of protecting the confidentiality of electronically transmitted data is founded upon certain well-established international principles.

4. Transborder data flow. International policy and regulation of TDF remains unsettled. Academicians, politicians and businessmen are aware of the growing market for transborder data transmission and are also aware of the pressing need for proper international accords.

Against a background of sound international principles, conflicting philosophies and policies have stalled the widespread adoption of consistent international regulations; instead, transborder data flow is regulated, where it is regulated at all, by a confusing mass of national laws and international accords often drafted for purposes of economic protectionism.(7) With the pressures of EC 92, the current state of affairs is a troublesome spectre with regard to Provider international activity. Motivated by concerns that the transmission of data by electronic means fundamentally alters the expections of privacy with regard to personal data, the international community took efforts in the early 1980's to adopt principles of confidentiality and freedom of information applied specifically to data processing and TDF concerns. However, the scope of those efforts, taken in the context of EC 92 considerations, has turned the resulting products into potentially protectionist tools. This has importance for Providers who have invested, or who are considering investing, in international interconnect activity.

B. Technology Transfer Restrictions.

Providers wishing to expand their business may have the opportunity to enroll subscribers outside the national boundaries of the country where the Provider is located. In addition, Providers have the opportunity to consider joint ventures involving foreign direct investments, to establish hubs of comparable quality to facilitate EDI, and have the opportunity to generate income by the export transmission of subscriber data across international boundaries. Independent of transborder data flow issues, national law restrictions on the transfer of technology may challenge aggressive business strategies, particularly with respect to the export of technical data through EDI.

1. Conflicting U.S. Authorities. Various U.S. agencies regulate exports including:

(a) The Department of State, through its Office of Munitions Control, regulates munitions' exports. Munitions are broadly defined to include equipment used with communications satellites, privacy devices, cryptographic devices and a wide variety of other equipment and related software.(8)

(b) The United States Patent and Trademark Office of the Department of Commerce regulates exports of materials related to foreign patent applications.(9)

(c) The Department of Commerce's Bureau of Export Administration ("BEA") generally regulates the export of non-military goods and technology.(10)

2. Basic Concepts.

a. Generally any export from the United States subject to BEA regulation requires a license. The identity of the export and its destination generally determine the type of license required.(11)

b. Destinations are classified by country on the Country Groups List. The foreign policy of the United States generally determines the status of a country. Thus, historically, communist countries have been subject to much more stringent regulation than democratic countries. Generally exports may be made to Canada free from regulation.(12)

3. General vs. Validated Licenses. There are two basic types of licenses available for exports, general licenses and validated licenses. A general license is available for use in connection with any transaction meeting the applicable requirements without the necessity of application.(13) If no general license is available for a specific transaction, then the exporter must apply to the BEA for a validated license before completing the transaction.(14)

4. Software.

a. Mass-market Software. Under recent revisions to applicable regulations "mass-market software" may be exported to most countries without the necessity of application with the BEA for a validated license.

b. Other Software. Software other than mass-market software must be exported under an applicable general or validated license.

5. Technical Data.

a. Definition. Technical data includes information that can be used in the design,

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production, manufacture, use or reconstruction of articles or materials. Technical data may consist of operating manuals or technical service. All software is technical data.(15)

b. General. Technical data may not be exported without a license. Therefore, care must be taken in determining whether any manual, information or service falls within the definition of technical data.(16)

c. Data Transfer. Data which is transferred out of or through the United States may be subject to regulation if it constitutes technical data.(17)

(1) That data may be transferred electronically was confirmed by reports of the Dresser events in 1982. In order to comply with restrictions upon the export of technical data, Dresser changed the entry key on a computer located in Pittsburgh, which effectively barred Dresser's French subsidiary from obtaining electronic access to the technology required to complete orders for products to be manufacture in France.(18)

(2) The question of whether a provider who is merely facilitating communication of technical data is responsible with regard to the technical data being communicated by its subscribers (or even by non-subscribers indirectly, via interconnect arrangements) appears to lack any authoritative guidance.

C. Data Publication Issues.

Recently, one commentator suggested that the published-information cases, whether framed in terms of product liability, or negligent misrepresentation analysis, support the proposition that tort actions against information publishers will not succeed unless the information publisher has clearly invited complete reliance on their information in directing the action of the reader or user.(19)

D. Private International Choice of Law Considerations.

The inherent qualities of global interconnect activity and TDF suggest that tough questions will be presented, in the case of a dispute, in determining the appropriate law to apply. The challenge is not new to any aspect of private international law development; what becomes uniquely delicate is the balance to be struck when contacts or relationships with the different forums may last for but a moment in time, and may not leave any record of the path of the transaction across any boundaries. At present, no ready principles exist to which one can point; much diversity is possible in solutions in dealing with multistate transactions analogous to those inherent to, or possible with, EDI.

NOTES

(*) An expanded version of this paper was presented at the Annual Meeting of the American Bar Association, Section on Business Law, on August 7, 1990.

(1) The Uruguay Round negotiations commenced with a commitment to considering trade in services, and have, in turn, focused on telecommunication data services and their role in facilitating domestic and international trade. *See generally* Robinson, *Electronic Highways for World Trade: Issues in Telecommunication and Data Services*, 2 (Westview Press, 1989) ["*Electronic Highways*"].

(2) *Id*. at 112.

(3) *Id.*

(4) A comprehensive report on electronic interchange and its implications with regard to commercial law, particularly domestic purchase and sale transactions, was recently published, accompanied by a model trading partner agreement to be used by companies implementing EDI. *The Commercial Use of Electronic Data Interchange - A Report and Model Trading Partner Agreement*, 45 BUS. LAW. 1645 (1990). The author and Professor Amelia H. Boss, Temple University School of Law, served as the co-reporters for the ABA task force which produced such publication.

(5) The functions of standards, and their impact upon EDI and comparable technologies, is an important consideration in trade policy and regulatory discussions but a more extensive discussion is beyond the scope of these materials. *See generally Id*. at 1703 *et. seq.*; *Management of Electronic Records: Issues and Guidelines*, 71-81 (United Nations 1990).

(6) *SITA: A Worldwide Telecommunications Service for Airlines*, PTC QUARTERLY (Dec. 1985).

(7) *See generally* Sauvant, *International Transactions in Services: The Politics of Transborder Data Flows* (Westview Press, 1986).

(8) *See* Sections 38 and 39 of the Arms Export Control Act, 22 U.S.C. §§ 2778-2780, and the International Traffic in Arms Regulations, 22 C.F.R. §§ 120-130.

(9) *See* 35 U.S.C. §§ 6, 181-88; 37 C.F.R. §§ 5.1-5.33.

(10) *See* Export Administration Act of 1979, 50 U.S.C. §§ 2401-20, and the Export Administration Regulations, 15 C.F.R. Part 700.

(11) 15 C.F.R. § 770.3.

(12) *See* Supplement No. 1 to 15 C.F.R. § 770.

(13) 15 C.F.R. §§ 771.1, .2.

(14) *Id*. § 772.1.

(15) *Id*. § 779.1(a).

(16) *Id*. § 779.2.

(17) *Id*.

(18) *A Delivery That May Be Dresser-France's Last*, BUS. WEEK, at 50 (Oct. 18, 1982).

(19) Toedt, *Reducing the Potential for Liability in the Dissemination of Computerized Information and Expertise*, 6 COMPUTER LAW. 2 (Nov. 1989).

ELECTRONIC DATA INTERCHANGE IN ASIA

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Abstract

Electronic Data Interchange (EDI) -- the use of computers and value added networks for electronic trading among business partners and governments -- is in the "early growth" phase in Asia. This paper is an overview of regional trends and market developments, focusing on "high level" obstacles to EDI acceptance, and market sizing (of users and EDI network revenues) for 1990.

EDI development in the Pacific Rim is marked by universal enthusiasm, but little urgency. While Electronic Data Interchange is recognized to be an important growth sector, it remains a relatively novel concept: its acceptance implies intensive investment in computers and software -- and dramatically new methods of business communication and administrative organization. EDI based on the UN/EDIFACT and ANSI X.12 protocols is just now becoming viable in the region: governments have begun to invest in national development programs for EDI awareness and standards implementation, and sophisticated users are exploring the benefits of standards-based communications networks. Political considerations governing market liberalization and industrial policy factor large in the EDI market development. Unlike the U.S., where EDI has evolved "ground-up" in response to industry needs, EDI in the Pacific region is generally a top-down planning effort led or administered by central governments.

There are two primary drivers behind EDI in the Pacific Rim today. First is market liberalization of enhanced services. While market deregulation of messaging and value-added network services is not required for the emergence of an EDI sector--Singapore, for instance, has the most successful system in operation, yet it is operated as a government monopoly--liberalization stimulates competition in high-end transport, and creates the "supply-push" incentive that helps lend legitimacy to EDI. In Australia, New Zealand, Hong Kong and Japan, multiple carriers vie keenly for market position, while the gradual loosening of government regulations in Korea and Taiwan promise more competitive provisioning in the future.

The second major driver is industrial policy for information systems, a relatively unknown concept in the U.S. Government programs range from exacting supervision of EDI R&D, administration and development (Singapore), to marketplace management (Hong Kong), to major market-priming initiatives (Korea), to almost no involvement at all (Japan). While the range of political sentiments is fairly wide in the countries implementing EDI, many are actively coordinating EDI infrastructure development. There are at least two reasons for close government involvement. First, governments believe the national interest will be compromised if industry (and the public) is not computer literate and making steady steps toward the "information age." EDI is viewed as an ideal technology for modernizing the economy. Second, commerce in Asia, owing to the vast geographic distances among trading partners, is import/export intensive, and port and customs-clearing systems are vital to national economic affairs.

In addition to individual national efforts, the forum for Asia Pacific Economic Cooperation (APEC), a ministerial-level organization comprised of 12 nations and modeled after the Organization for Economic Cooperation and Development (OECD), is attempting to bring continuity to regional EDI planning. APEC is represented at the working group level by national committees of the Pacific Economic Cooperation Conference (PECC). APEC has targeted telecommunications as a key area for observation and negotiation, and EDI is one of four priority topics for the telecommunications agenda. New Zealand, represented by the New Zealand Customs service, chairs the EDI working group.

While the APEC/PECC agenda for regional EDI has not been formally articulated, the New Zealand proposal is expected to call for open links between regional passenger-and customs-clearing systems. Some American industrial observers are concerned that the New Zealand initiative will be designed by governments--a trend, they argue, which implies that regional EDI may become regulated by state agencies rather than the marketplace. The exact nature of the PECC deliberations on EDI will become more apparent throughout 1991.

Obstacles to Industry Development

An obvious obstacle to smooth deployment of EDI in Asia is the absence of unambiguous EDI standards, both regionally and on a country-by-country basis. Generally speaking, the emerging worldwide standard for EDI is based on EDIFACT--EDI for Administration, Commerce and Transport, as defined by the Working Party on Facilitation of International Trade Procedures of the United Nations Economic Commission for Europe--but the ANSI X.12 protocol widely used in North America has a powerful impact on the design of global systems. Figure 1 shows that four of seven countries surveyed have selected EDIFACT (Australia, New Zealand, Hong Kong and Singapore), one has opted for ANSI X.12 (Korea), and two are undecided: Japan is likely to adopt EDIFACT while it is simply too early to tell in Taiwan. It is important to note that a national endorsement of the EDIFACT standard does not preclude support for ANSI, and visa versa--and in fact most do. At issue is primary development spending.

Figure 1:

Standards and Market Drivers

Country	Standard	Political Drivers	Primary Carriers
Australia	EDIFACT	NZ Customs;	OTC; Telecom Australia; NEIS; PACSIS; GEIS; IBM
NZ	EDIFACT	EDICA; Tradegate; Standards Australia	GEIS; Netway
Singapore	EDIFACT	Singapore Network Systems (SNS)	SNS
Hong Kong	EDIFACT	Tradelink; SPEDI	HKT-CSL; INET; Gazettenet; Infolink
Japan	N/A	MPT; MITI	NTT Data; Nomura; NEC IBM; GVJ; AT&T
Korea	ANSI X.12	MOC; NAIS	Dacom; KT-Net
Taiwan	N/A	MOEA; III; DGT	DGT; TTN

Note: N/A in Japan and Taiwan means "not determined". Japan is likely to adopt EDIFACT, whereas Taiwan is still in a formulative development stage.

Note: A national endorsement of the EDIFACT standard does not preclude support for ANSI, and visa versa.

Sources: Interviews with PTTs and carriers, and "Status of EDI Development in Asia/Pacific," Promotion for the Information Industry Association (Taiwan).
Note: N/A in Japan and Taiwan means "not determined". Japan is likely to adopt EDIFACT, whereas Taiwan is still in a formulative development stage.

Though the majority of countries have pledged compliance to the evolving international EDIFACT standard, the reality of the marketplace demands that working solutions based on ANSI (North American) protocols be adopted to provide immediate service needs. Having made substantial investments in software platforms and networking technology ascribing to the ANSI standards, will national EDI providers convert existing network architectures to EDIFACT when the EDIFACT message sets become more widely available? How practical is it for a government to "commit" to EDIFACT even as large (multinational) users are already aligning with the North American standard? And what happens if the technological migration path from ANSI to EDIFACT is not as smooth as some would hope? These questions will be most pressing in Singapore and New Zealand where the ANSI protocols are already used extensively.

Another technological issue looming for the future is X.400. X.400 is widely discussed, but the level of EDI traffic riding the protocol within or across the Pacific is negligible. The main proponents of the technology are, characteristically, international voice carriers branching into messaging networks and data VANs--among them AT&T, Cable and Wireless, and Australia's OTC. As the specifications for the Pedi version of X.400, X.435, become available, perhaps by YE92, X.400 shall, like EDIFACT, become a significant standard in global messaging nets.

"The current lack of standards," as one observer aptly noted, "is a barrier to regional EDI growth. But having a standard is not necessarily a catalyst." Other factors contribute mightily to the difficulties of EDI acceptance in the Asia/Pacific. Among them is labor costs. American companies have embraced EDI partly in effort to realize the promise of reducing administrative overhead--an effort often aimed at responding to foreign competition. In many industries, this competition has come from the newly industrialized countries in Asia: Korea, Hong Kong, Singapore and Taiwan. These same countries, by contrast, enjoy relatively low labor rates and rarely view EDI as a defensive investment. Rather, EDI is regarded as a vehicle to institutionalize trade gains won during the 1980s and to ensure that global trading links remain healthy.

A related difficulty pertains to the very nature of electronic trading via EDI. All successful companies are conservative by nature, but Asian firms in particular are resistant to technological solutions to established business practices. The penetration of data processing facilities is often uneven, and the psychological (and topological) leap into EDI transaction processing is a far more difficult sell in Oriental cultures than it is in the West. In some countries, major investments in software are sometimes viewed with suspicion. Another factor is geography. With literally tens of thousands of miles separating regional trading partners, the immediacy of electronic trading for just in time manufacturing, an increasingly popular EDI application, loses much of its panache.

Market Size

There are a number of difficulties associated with assigning market value to EDI network revenues in the Pacific Rim, not least of which is: "It depends on what you mean by EDI." For instance, can an EDI-like "structured message" file transfer transmission that does not conform to either the ANSI X.12 or EDIFACT protocol be considered EDI? By accepted definitions of EDI, the answer is yes. The following market assessment, however, attempts to make the distinction between standards-based EDI -- "true EDI" -- versus "traditional EDI", or structured file transfer. The figures which follow pertain to network revenues associated primarily with the two dominant protocol structures, ANSI X.12 and EDIFACT. This bias invariably leads to difficulties. Japan, for example, has an extremely active electronic trading sector, but the proportion of network traffic formatted in the ANSI or UN protocols is thought to be quite small. The market for "traditional" EDI in Japan--employing proprietary Japanese protocols--amounts to about $14.4 million in 1988, but "true EDI" is thought to total only about $4 million.

A second major difficulty in market sizing--which will grow more difficult as the sophistication of integrated messaging technology becomes more complex with time--is the emergence of what some observers refer to as "multi-object documents." As EDI is coupled increasingly with other forms of messaging, such as electronic mail, voice mail, and fax store-and-forward, making the distinction between EDI-specific traffic and everything else will become increasingly difficult.

These qualifications made, there are estimated to be about 3,200 EDI users of "true EDI" in Asia. (See Figure 2.)

FIGURE 2:

Asia/Pacific EDI User Base, 1990
(ANJSI X.12 and EDIFACT)

Country	# of Users
Australia	1,000
New Zealand	50
Singapore	1,600
Hong Kong	50
Japan	75
Korea	146
Taiwan	10
Total	2,931

Source: LINK Resources

The market for network revenues associated with "true EDI" in these same seven countries in 1990 is estimated at $10.1 million. Ramp-up is expected to be slow. Assuming that most markets grow on average 60% annually, the regional revenue total in 1995 may reach $88.3 million. (See Figure 3.)

Figure 3:

Network Revenues for "True EDI" in Asia

($ millions)

Country	1990	1995
Australia	2.75	25.45
New Zealand	0.35	5.24
Singapore	1.5	13.88
Hong Kong	1.0	11.26
Japan	4.0	22.21
Korea	1.0	7.26
Taiwan	0.0	3.00
Total	10.6	88.30

Source: LINK Resources

Considering the size of the overall market, foreign VANs can not and should not expect to earn bountiful new wealth from the Asian EDI arena. With competition split among as many as 10 suppliers in key markets, incremental growth will be extremely small. Most carriers, as a result, expect that EDI will account for only about 5%-20% of network traffic. EDI will thus be only one element in a composite package of message services. Over the next several years, greatest profits will be earned from software sales, system design and configuration, and training.

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1 This article was adapted from the Executive Summary of "EDI in the Pacific Rim," a comprehensive survey of EDI development in Asia, published by LINK Resources Corporation, 79 Fifth Avenue, New York, NY 10003.

Partners In Progress -- An Overview of the Telecommunications Industry Forum

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The Telecommunications Industry Forum (TCIF) was originally formed in June of 1986 to ad-dress the growing need for voluntary standards dealing with Electronic Data Interchange (EDI) and bar code technology within the telecommunications industry. The purpose of TCIF is to provide a forum for purchasers, manufacturers and suppliers of telecommunications equipment, products and services to address issues relating to industry standards associated with the provision and procurement of such equipment, products and services. TCIF is dedicated to the achievement of common benefits through this cooperative effort between such trading partners within the industry.

Today TCIF member companies account for approximately 125 million of the 131 million access lines in the United States. And, as the majority of the smaller carriers are members of the United States Telephone Association, which is also a TCIF member, we truly represent the exchange and interexchange carriers in the United States.

A review of the list of manufacturers and suppliers holding membership in TCIF will also reveal that we represent a substantial number of the companies that supply the ex-change and interexchange carriers. In fact, the manufacturers and suppliers outnumber the carrier side by approximately 3 to 1. It is interesting and understandable to note that several Pacific Telecommunications Council Members are also TCIF Member Companies.

There are four working committees in TCIF. The Bar Code Committee was instrumental in the selection of Code 39 as our industry's bar code symbology of first choice. They have issued a Bar Code Implementation Guide, a Package or Shipping Container Bar Code Label Specification and a Product Package Label Specification. They will be issuing guidelines for direct product marking in the near future.

The Standard Coding Committee is developing guidelines and formats for information com-monly exchanged between trading partners. For example, they have established a product identification guideline which suggests a structure for product descriptions. Working closely with the Bar Code Committee, they have developed a Cable Reel Tracking Speci-fication. They will be issuing guidelines for direct product marking in the near future.

The Information Product Interchange Committee (IPI) is establishing guidelines for the electronic exchange of product information including technical specifications and maintenance instructions. Transmitting text and graphics electronically is viewed as essential for maintaining accurate and up-to-date records in an industry where technology is evolving rapidly. In addition, delivering documentation electronically will help ease the burden on existing paper management systems ultimately providing better infor-mation to users.

The TCIF EDI Committee has issued interpretations or guidelines for almost all of the customary business transactions to be accomplished via EDI. All of these transactions are based on, and in full accordance with, ANSI X12 transaction sets. TCIF has an on-going program to keep current with the latest releases of ANSI X12 and is also de-veloping additional transaction sets. Presently, they are preparing a transaction set that will permit major customers to place service order requests via EDI and they are working on an ANSI 811 transaction set to facilitate the EDI rendering of the monthly telephone bill.

The 811 Telephone Bill transaction set has created a high level of interest in our in-dustry and in other industries. Southwestern Bell is estimating that they can save $3.9 million annually by using EDI to bill their customers for telephone service. They have initiated a pilot program with Texas Instruments to redefine their estimates and to define the necessary procedures. AT&T has also implemented several pilot billing programs.

A recent survey of much of our industry indi-cated that 83% of the respondents were inter-ested in Electronic Funds Transfer (EFT). Accordingly, a new EDI Sub-Committee to examine EFT was formed in September. They will use existing standards such as ANSI X12 for EDI and the NACHA (National Automated Clearing House Association) standards for financial transactions between banks. Where necessary, the committee may need to request changes to these standards to meet any unique requirements of the telecommunications industry.

Southwestern Bell estimates that the cost of processing a vendor bill will go from $3.00 to just 40 cents using EFT. Another major institution, the U.S. Government is also interested in EFT and believes it will reduce their costs of paying vendor bills from 30 cents to an estimated 4.5 cents per bill using EFT.

Today, many of our member companies are implementing EDI and bar coding. Pacific Bell presently sends EDI Purchase Orders to approximately 100 vendors. Their processing costs went from $72 each using paper to just $9 using EDI. They have advised their vendors that EDI and bar code labeling at the package level are to be considered conditions of doing business with them. AT&T utilizes the technology to reduce the time required to offload vehicles at one of their facilities from an average of 70 minutes to an average of just 7 minutes. Telesector Resources reports that they have been able to greatly reduce inventory levels at their stocking locations.

Bar Coding and EDI are tools that can be utilized to increase productivity and neither technology should be considered as a technical issue. Eventually, every company re-presented in this room will save money through these technologies, but the money lost through delay can never be recovered. TCIF would be pleased to assist you in your efforts to take advantage of this technology and to become a "Partner in Progress".

HAWAII: CENTER OF THE PACIFIC TELECOMMUNICATIONS VOLCANO!

DENNIS W. ELLIOTT

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Hawaii is emerging as a crucial hub for commerce and communications in the Pacific region. It's becoming the center of the PACIFIC TELECOMMUNICATIONS VOLCANO!

Hawaii over the period of modern telecommunications has seen ebbs and flows of telecommunications activity. In the first half of the twentieth century, Hawaii emerged as a crucial communications hub in the era of high frequency wireless telegraphic communications. For example, RCA had a major high frequency radio telegraph site on Oahu. In this period, Hawaii was a major center in the Pacific for communications traffic from east to west and north to south.

In 1957, the first analog coaxial submarine cable from the U.S. mainland to Hawaii was put into service. It had 36 voice channels. In 1964, a new analog coaxial submarine cable with 128 voice channels was laid, island hopping through the Pacific from the U.S. mainland to Oahu to Midway Island to Wake Island to Guam to Japan. Hawaii continued to play an increasing role in Pacific communications.

Then came Intelsat! While Hawaii was regarded an international point, even by the U.S., and received its own huge Standard A earth station complex, its role began to diminish as even a waypoint for Pacific communications. Satellite transmissions could jump oceans! Also, since Intelsat came into existance through international treaty, there was a definite political push toward using satellite circuits. During this period of the late 1960's to the late 1980's, Hawaii's access to high quality facilities initially grew and then leveled off on a relative basis. This tended to limit economic growth.

But change again came! With the new HAW-4/TPC-3 fiber optic submarine cable placed into service in 1989, another phase of Hawaii's role in Pacific communications began, albeit modestly.

But before we look at what's in store for Hawaii in this decade, let's look at some of the developmental forces behind the plans and dreams of the Hawaii-Pacific communicators.

The forces behind Hawaii once again becoming a major hub in the Pacific can be divided into two categories. The first is the evolution of trans-Pacific telecommunications which now employs an ever growing web of undersea fiber cables. The other growing developmental force is the growth of Hawaiian industry and services and its need to communicate not only with the rest of the United States but also with the rest of the world. Overlaying both, of course, is the technology developments of fiber optics with its diminishing cost per unit of capacity over point to point routes, SONET and ISDN, broadband switching, video compression and interactive multimedia technology.

According to Bank of Hawaii statistics, Hawaii's real economic output ("gross state product") has grown, on average, over 40 percent faster than the U.S. overall and even slightly faster than Japan over the last five years. Looking at Hawaiian industry and services, four major sectors can be expected to generate most of the growth in the coming decade:

> (1) Tourism. Tourism itself grows moderately in Hawaii but as new communications services are made available and old services become significantly cheaper, then overall demand for telecommunications facilities is expected to outgrow the underlying growth in tourism as measured by number of tourists.

(2) Defense. The U.S. Department of Defense, as it responds to restructuring its Pacific presence and budgets constraints, will generate needs for a more sophisticated network approach which will demand more digital facilities but yet moderate the overall cost of the defense mission.

(3) High Tech. High technology industry and services are expected to bloom in Hawaii's greenhouse with, I might add, a great deal of state encouragement. The high tech area covers a broad range of endeavers. For instance, the Hawaii Space Development Authority continues to push toward a commercial satellite launching facility which will require heavy telecom services. A software service center is in its early stages where software development companies develp their product and sell use of the product over telecommunications lines. And of course the ever increasing buildup of high tech hardware and software concerns requires general telecom facilities.

(4) Financial Services. Because of Hawaii's situation of being in a time zone which overlaps both eastern Asia and the mainland U.S. during the business day, certain financial trading services may develop in the near future. For instance, its generally known that serious discussions are taking place between the American Stock Exchange and Hawaii business development interests to bring a trading center to Hawaii. Also, it's known that some trading concerns are seriously considering locating major trading operations to Hawaii from east Asia.

Now let's look at what's developing around Hawaii during the 1990's. A trans-Pacific web is developing with Hawaii at its focal point. Undersea fiber optic cables come from the U.S. mainland, from Australia and New Zealand, from Japan, from Guam and southeast Asia. They all meet in the middle of the Pacific Ocean: in Hawaii.

We begin with today's small and at capacity HAW-4 and TPC-3 fiber optic cables between the mainland and Hawaii and between Hawaii and Guam/Japan, respectively. We add the ALOHA cable in late 1992 or early 1993 which will relieve the current constraints to the mainland as well as allow the four growth sectors previously outlined to grow unfettered. Then, also in 1993, we add the HAW-5 and PACRIM-EAST cables between the mainland and Hawaii and between Hawaii and New Zealand, respectively. All of this capacity (ALOHA and HAW-5 will each have twice the capacity of the existing HAW-4 cable) will then match up with the North American fiber networks as well as the north Pacific cables which transverse from the west coast of the U.S. to access eastern Asia fiber networks.

Hawaii will then begin to act as a network hub for the central and south Pacific. In addition, substantially more robustness and redundancy will be gained in the Pacific network to lessen the vulnerablity to single point failures. With the new fiber optic cables capable of carrying so much capacity, the amount at stake is substantial for any given cable and the old trick of using standby satellite capacity to restore doesn't work because there isn't enough satellite capacity to restore the new cables.

As a result, by 1993, Hawaii will have a number of cost-effective, high quality, high capacity digital transmission facilities radiating east, west and south. Throughout the region, we can expect a broad movement and growth of point-to-point telephone and data to the Pacific fiber cable network. As regional fiber networks grow more complex in east Asia, as Mexican and other Latin America economies develop requiring high quality telecommunications facilities, as needs to tie the Pacific Rim more directly to Europe increase, then other links with Hawaii as a central node will be planned. Hawaii is truly becoming the center of the Pacific telecommunications volcano!

Intelligent Network Developments in Australia

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1.ABSTRACT

This paper examines the objectives when implementing Intelligent Network developed services for telephone operating companies, hardware and software suppliers and users. Discussion in this article will focus on the objectives of Telecom Australia, a discussion of the recently implemented CustomNet™ Services and comparison of the implementation and its objectives. This focus will also include an examination of the implications for both the telephone operating companies and the end users. Finally, a brief overview of the status of Intelligent Network standards.

2. Objectives of Intelligent Network Developed Services

2.1 The Intelligent Network Objective

Telecom Australia (TA) and Northern Telecom have joined together to build and implement a platform to provide Intelligent Network developed services throughout Australia. The key objective of an Intelligent Network (IN) is to deliver telecommunications services desired by subscribers in an efficient and flexible manner. Efficiency is required both by the telecommunications operating company and the users. Flexibility is critical to the operating company providing the service.

2.2 Objectives of Stakeholders

Implementation of an Intelligent Network developed capability requires merging the needs and interests of three different groups: the telephone operating company, telecommunications equipment suppliers and business users.

With their large existing investments, telephone operating companies require solutions which can be implemented to work economically within their existing Public Switched Telephone Networks. They require the ability to tailor services to the business needs of their customers, the ability to accelerate the development of new services, and the flexibility to control how those services are implemented and their operation.

Intelligent Network equipment suppliers must minimize the time and cost of both the hardware and software development. Intelligent Network developed services are software intensive, and equipment suppliers must reduce the management of the large amount of software required to implement these services. In addition, it is essential that they improve efficiency of the software generation through use of modular code.

Business users are seeking to gain control of those communications services which are critical to their business operations. At the same time they are seeking to reduce the cost of their communications services, and to improve the stability of their transactions. They desire to use communications to open up new markets and even new areas of business.

2.3 Telecom Australia's Objectives

Like businesses in many countries, Australian business is demanding ever more sophisticated communications services to increase their competitive edge both domestically and in the global marketplace. The major objective of TA is to meet this demand and to take advantage of the many opportunities for new communications services as they emerge. As a business, TA is seeking to increase revenues from IN services and to retain profitability by offering these services.

One of the key corollaries is that provisioning lead time to implement new Intelligent Network developed services must be reduced from the kind of lead times experienced in the past. In today's dynamic business environment, the typical 36 month cycle to implement a new telecommunications service is unacceptable. Times of 6 to 12 months are the maximum acceptable for implementation of services.

Another corollary is the requirement to minimize capital costs. Implementation of new services in the past has required investment of large amounts of capital to purchase hardware and software to implement the services. It would be impossible to meet the burgeoning requirements for new services if large amounts of capital were required for every new service.

Until recently, businesses have turned to the use of customer premises equipment to obtain advanced communications services. One of the most important things Telecom Australia has to offer is much higher reliability because advanced services can be based on public telecommunications equipment. Public telecommunications equipment is built to high reliability standards - typically .999955 (2 hours of down time in 40 years). The cost of this level of reliability is usually not affordable for businesses implementing services derived from their own customer premises equipment.

In addition, Telecom Australia PSTN is able to provide a much higher level of flexibility and diversity simply because the cost of the network resource to provide the services is shared over many businesses.

3. Meeting the Objectives

3.1 Network Architecture

Telecom Australia and Northern Telecom have met these objectives. The implementation of Intelligent Network services is based on the integration of Intelligent Network developed technology into the existing CCITT No. 7 based Public Switched Telephone Network (PSTN), in the form of an Intelligent Network Overlay. Figure 1 shows the network architecture which has been implemented. No upgrade was required at the local central offices.

The Service Switching Points (SSPs) of the IN Overlay are connected to the PSTN via CCITT Signaling System Number 7 (CCS7). More specifically, the Australian version of the Telephone Users Part, ATUP is used for this interface, The Australian version of the ISDN User Part (AISUP) will be used to interface to ISDN capable switches. The SSPs also interface to the Australian Packet Switched Network, AUSTPAC™ via a PCM30 Link. Initially four SSPs, located in Melbourne, Sydney and Canberra, provide access to the Intelligent Network on a national basis. The initial implementation of the Australian TUP interface has been operating for nearly one year.

The Service Switching Points (SSPs) connect to the Service Control Points (SCPs) via TCAP. There are two SCP systems, one located in Canberra and one located in Adelaide. An SCP OAM System connects to the two SCPs for service updates and management.

3.2 The Intelligent Network Platform

Northern Telecom DMS-100 SuperNode™ systems were chosen for the SSPs and SCPs. The DMS SuperNode™ is a highly capable application platform for the provision of a wide range of telecommunications services including Intelligent Network services. Figure 2 shows the DMS-100 architecture. It features a multiprocessing environment for implementing IN and other services on Application Processors (AP). Centralized data bases are essential for most IN services today. These are provided through the File Processors (FP). CCS7 interfaces are provided through the Line Peripheral Processor (LPP) and the Digital Control Processor (DCP) provides X.25 interfaces. The DMS-Bus is a high speed transaction bus which makes it possible for many different services to run together on this architecture.

This highly modular architecture provides a very economic base for implementation of IN services, which will evolve as communications technology evolves. The telecommunications operating company revenue stream is protected through unsurpassed node survivability, resulting from the redundant subsystems. Reduced operating costs come from the use of common hardware, integrated OAM, and conformance to international standards.

3.3 Telecom Australia Intelligent Network Services

Many different Intelligent Network developed services are being considered today by telecommunications service providers throughout the world. The specific services which have been implemented by Telecom Australia are CustomNet Spectrum™ [Centrex], CustomNet Horizon™ (a Virtual Private Networking [VPN]), TELECARD™ an Automatic Calling Card Service and enhanced freedial service [E008], being an increment to the existing 008 service.

3.4 TELECARD™

Basic operation of TELECARD Australia's Automatic Calling Card Service is shown in Figure 3. To access the service a user dials in through an existing local exchange. Recognizing that an IN service is required, the local exchange routes the call to a Service Switching Point (SSP). Software in the SSP generates prompts back to the user to enter a calling card number and a Personal Identification Number (PIN). This number is sent by the local exchange to the SSP. Using this number, the SSP verifies whether the call is authorized through a data base in the Services Control Point (SCP). When the call is authorized, the SSP completes the call, by routing it to the appropriate destination.

Services

E008
ACCS
Austcall

IN Network - Australia

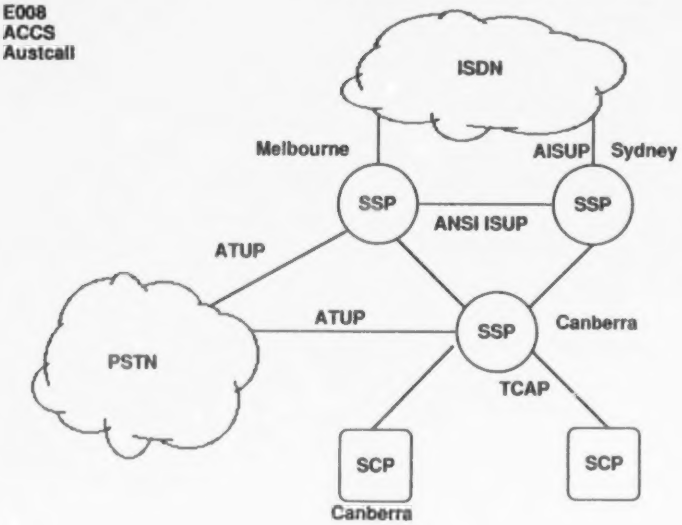
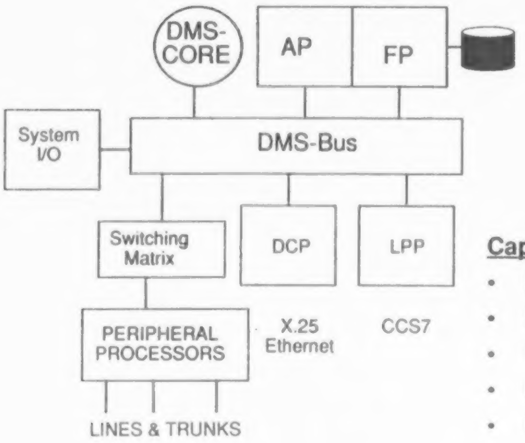

ISDN
Melbourne
AISUP
Sydney
SSP
ANSI ISUP
SSP
ATUP
ATUP
SSP
Canberra
PSTN
TCAP
SCP
Canberra
SCP

Figure 1

SUPERNODE ARCHITECTURE


DMS-CORE
AP
FP
System I/O
DMS-Bus
Switching Matrix
DCP
LPP
PERIPHERAL PROCESSORS
X.25 Ethernet
CCS7
LINES & TRUNKS

Capabilities:

- Multi-processing environment
- Subsystem redundancy
- Industry standard interfaces
- High speed transaction bus
- Integrated database

Figure 2

AUTOMATIC CREDIT CARD SERVICES - BASIC OPERATION

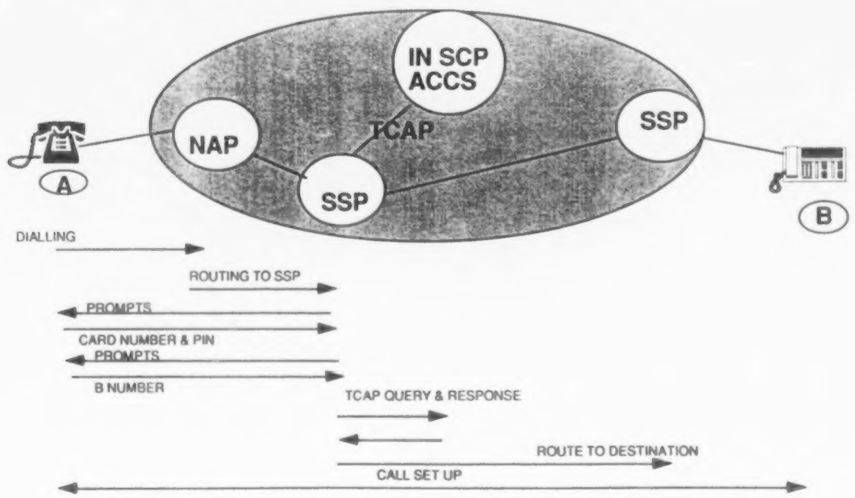

IN SCP
ACCS
TCAP
NAP
SSP
SSP
A
B
DIALLING
ROUTING TO SSP
PROMPTS
CARD NUMBER & PIN
PROMPTS
B NUMBER
TCAP QUERY & RESPONSE
ROUTE TO DESTINATION
CALL SET UP

Figure 3

E008 SERVICE - BASIC OPERATION

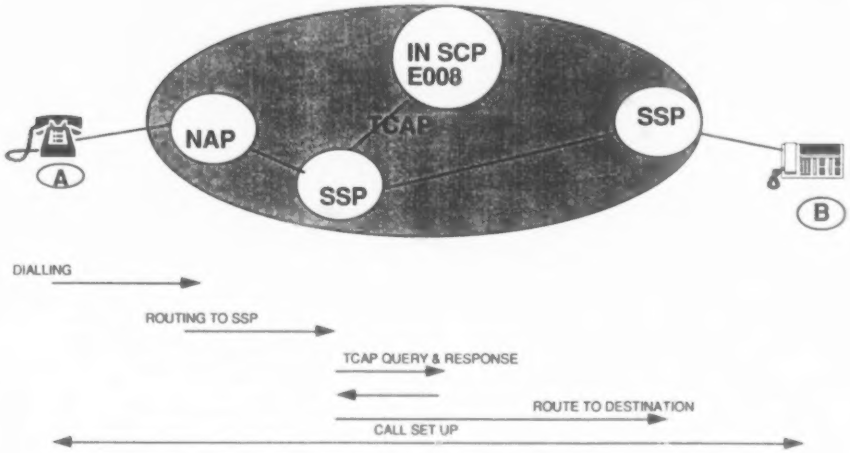

IN SCP
E008
TCAP
NAP
SSP
SSP
A
B
DIALLING
ROUTING TO SSP
TCAP QUERY & RESPONSE
ROUTE TO DESTINATION
CALL SET UP

Figure 4

The flexibility of this IN platform is evident in the many features of the TELECARD™ service. These include: automatic access, qualified calling, voice prompting, call thresholds, PIN hunting, follow on calling, input correction, customer selected PIN and qualified connection. Customers access the TELECARD™ service automatically through existing stations connected to the PSTN. Manual access through an operator is also an option. The data base can verify not only whether the user is qualified to make the call, but can verify whether the user is qualified for particular connections.

Voice prompting makes entry of the Personal Identification Number (PIN) fool proof. Numbers of calls are tracked and when thresholds are exceeded, appropriate action can be taken. Customers can make multiple calls with a single entry of their PIN by pressing the "#" to make another call. A similar sequence can be used to correct digits that were input in error.

These features translate directly into benefits both for Telecom Australia and for users of the service. Automatic access, voice prompting, qualified calling and qualified connection all reduce operator working time. The many features of the service make it very flexible for use by different kinds of businesses. This allows tailoring the service to individual users. The centralized data base simplifies administration of the service and makes efficient use of network resources. The high level of security built into the service provides a higher level of confidence on the part of the customer.

Use of the PIN significantly improves cost control for businesses by ensuring that only authorized users are allowed to make calls, and by controlling the kinds of calls they can make. The PIN also allows improved accounting, with charge back to individuals. The security features make it virtually impossible for anyone to use another individual's PIN, unless that person gives the PIN to them. The fact that the service can be accessed from anywhere in Australia provides improved communications from the field, when users are travelling. This allows users to return calls to their customers more promptly, wherever they are, making the business more responsive, and improving the image of the business in the perception of its customers.

3.5 E008 Service

Basic operation of the E008 Service is shown in Figure 4. It is similar to the ACCS service except that instead of sending a PIN from the SSP to the SCP for verification, the SSP sends the E008 number to the SCP for translation. The SCP returns the translated number for the destination to which the call is to be completed and the SSP then completes the call.

As with the ACCS service there is a high degree of flexibility. The fundamental service, single number calling, is powerful in its own right. But many additional features enhance the service. Variable call routing allows a high level of customization of the service. Calls may be completed to different destinations depending on the origin of the call and on the time of day the call is made. For example, calls may be completed to the office closest to the caller, in a nationwide real estate agency calls may be routed to different answering points depending on time of day, allowing for more efficiency in the business.

Recorded announcements can be used to customize the service to the needs of individual businesses. Automatic message accounting is available to improve cost control. The ability to route commands from the SCP to the SSP increases the flexibility of the service. Calls can be allocated to various centers based on logic built into the SCP data base.

There are benefits for both the telephone operating company and for the user. The service is available nationwide and is fully featured. The flexibility of the features allows the telephone company to tailor the service to the needs of individual businesses. The centralized data base simplifies both network operations and administration substantially over older variations of this service which had a high maintenance overhead, when the translation data base in every switch in the network required updating, every time there was a change. And the architecture makes more efficient use of network resources.

Businesses making use of the service experience improved cost control, while their customers experience improved service and responsiveness. Use of the service expands business' coverage nationwide, or to all regions of the nation they want to cover. All of this leads to an improved service image for the business.

3.6 CustomNet Horizon™

Telecom Australia will be implementing CustomNet Horizon™, a virtual private networking service for Australian business. Basic operation of the service, shown in Figure 5 for Roving Access, is similar to the ACCS and E008 services.

CustomNet Horizon™ is a customised network facility which provides the capabilities of a dedicated network service but uses Telecom's switched network resources to configure their own virtual corporate network as shown in Figure 5. Businesses can also have optional direct access to the SSP via CustomNet Spectrum™ as described below. Within this network calls may be completed to offnet or On-net locations. A full set of advanced private network features is available, which could be extended to international locations in some cases and be integrated with dedicated networks. These will allow the customer to "activate"/"deactivate" stations

AUSTCALL - BASIC OPERATION, ROVING ACCESS

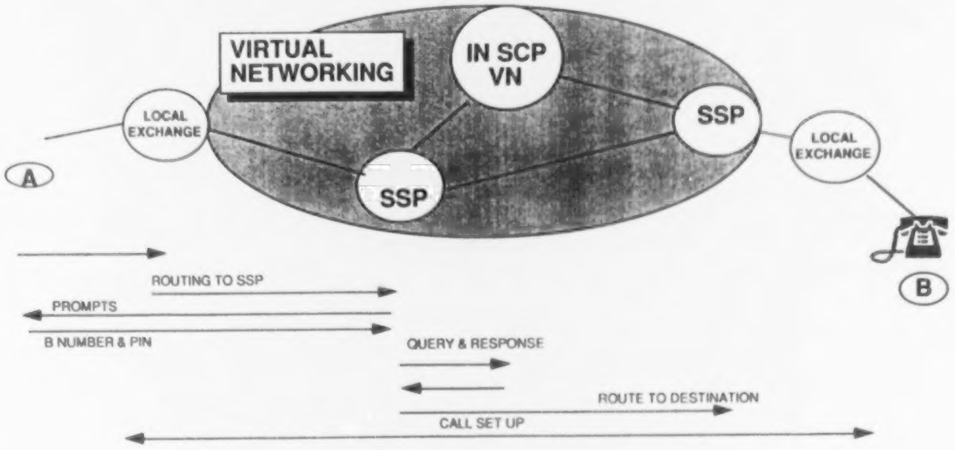

VIRTUAL NETWORKING
IN SCP VN
LOCAL EXCHANGE
SSP
SSP
LOCAL EXCHANGE
A
B
ROUTING TO SSP
PROMPTS
B NUMBER & PIN
QUERY & RESPONSE
ROUTE TO DESTINATION
CALL SET UP

Figure 5

from their virtual private network, allow barring status to be changed (eg.STD, ISD).and statistics that will allow monitoring on a periodic basis and management of the network.(eg percentage of calls blocked or overflowed)

As with the other CustomNet™ services, Telecom Australia will provide the benefit that CustomNet Horizon™ will be available to businesses on a nationwide basis, with the ability to tailor the service to the different ways in which individual businesses operate. The same kinds of features, only available in PABX based private networks today, will be made available to customers through the public network. Customers experience reduced costs through sharing switched resources, and from maintenance of routing tables, authorization tables, etc. by a skilled Telecom Australia operations staff at the central location. The result is a more efficient and effective operation for both the telephone company as well as for businesses using the service.

3.7 CustomNet Spectrum™

CustomNet Spectrum™ is being promoted as a service that delivers advanced call handling capabilities, equivalent to those of fourth generation PABXs, from the network, replacing the need for a customer to purchase PABXs or Small Business Systems (SBS). With the handsets being connected directly to the public telephone network, it is able to utilise the networks intelligence to provide call handling functions for single or multi-site locations which could be on a national bases.

CustomNet Spectrum™ will be provided over traditional copper loop facilities and where practical via fibre with an on site remote to deliver analogue or digital ISDN Basic Rate Access (BRA) capability. A basic set of call handling features is incorporated in the service rental, and may be arranged or activated per the customers specifications. Optional features and feature packages are also available, allowing CustomNet Spectrum™ to be tailored to meet the each customers requirements.

4. Implications for Telecommunications Operating Companies

4.1 New Revenue Generation

Intelligent Network services have a demonstrated potential as generators of new, previously untapped revenues for telephone operating companies. With pressure for usage discounts from businesses with high volumes of traffic Intelligent Network functionality allows the carrier to deliver the expected discounts and provide the means by which to recovery all or part of these lost revenues.

4.2 Ease of Implementation of New Services

We have discussed the services which have been implemented and which are planned for implementation in the near future. However, these are only the beginning. The platform for advanced services which has been implemented is highly flexible, and new services will be implemented as requirements increase. Centralized implementation in the SCPs makes it much easier to implement new services than when the software had to be loaded into every switch in the network. New services can be implemented more rapidly on this platform, and services which have been implemented already can be maintained more easily than when they are scattered throughout the network.

4.2 Key role of CCS7 and Resident Processing Power

Deployment of this strategy has placed an increased dependence upon the overall network intelligence transfer capabilities and resident processing requirements. CCS7 (ATUP) is essential for moving information such as voice prompts and PINs between the existing network local exchanges and the SSPs. CCS7 (TCAP) is used for the extensive information transfer and interaction which takes place between the SSPs and the SCPs. None of this would be possible without the power inherent in the advanced signalling capabilities of CCS7.

Extensive processing power is required. Locating this processing power in the network overlay ensures that existing capacity of the PSTN is not affected by these extensive new services. The planned evolution of the DMS-100 SuperNode™ ensures there will be enough processing power for many future new services, as well as the services which have already been implemented and which are being implemented.

4.3 Increased Interdependence between Services and Services Support

Users view these services as part of the network. The increased dependence on network signalling and processing power have a significant impact on network management systems in place. Telecom Australia has refined its operational procedures to ensure that customers receive all the benefits they expect of the Intelligent Network developed services, and to ensure that existing services are maintained at the same high level of reliability.

Unlike POTS service, support systems for maintaining the Intelligent Network Developed services have become an integral part of the service offering itself. This is a new way of doing business. In the past, support systems and services have operated quite well as separate entities. Now, TA has initiated much closer planning and coordination between the service offerings and their support systems.

5. Implications for Users of Intelligent Network Developed Services

5.1 User Demand

Implementation of these Intelligent Network Developed services is good news for users of the services. Demand for services has been evident in the extensive use of PABXs and other customer premises equipment to provide advanced services which telephone operating companies around the world were unable, or unprepared to offer. These services have been demonstrated to benefit the businesses employing them.

5.2 Benefits of Scale and Restoration of Business Focus

However, implementation and operation of these services on the customers own equipment has been a costly way of doing business, and has diverted a part of the business from its main focus to the telecommunications business. Now, with the implementation of services on an IN overlay platform, customers can experience reduced costs and more efficient operations as a result of the benefits of scale they enjoy. Centralized implementation of services on telephone company resources allows sharing the cost of the hardware and software resource, as well as the cost of the staff to operate and maintain the services. Much higher levels of reliability can be achieved by making use of central office technology which would not be affordable to most individual businesses.

The telephone operating company can provide service to a wider geographic area than is feasible and cost effective for most businesses implementing their own private network. Thin route areas are served just as easily from the existing public network as dense metropolitan areas.

5.3 Customization of Service

Most important of all is the ability to customize the services to the "culture" of individual businesses. The TA CustomNet™ service offerings have much more flexibility than is available in most private network implementations. And the staff who implement these services for individual corporate businesses are skilled in adapting the services to their specific needs.

It is precisely in the area of customization that businesses realize the greatest benefit from the CustomNet™ services. Telecom Australia Account Teams will work with the individuals responsible for corporate communications among its customers to implement a version of the service which will give that company the greatest competitive edge achievable through communications.

These advanced capabilities and inherent flexibility are also being directly implemented into packages for general business through TELECARD™ and the E008 service.

6. Futures

The field of Intelligent Networks is new. Telecom Australia's range of CustomNet™ services and its general business offerings of TELECARD™ and E008 are part of the initial Intelligent Network Developed services to be implemented in the world. Because the field is new, standards do not yet exist. Extensive work is underway to rectify this situation, but it will be some time before there is agreement among all the vendors of IN hardware and software in both the computing and the telecommunications industries to allow their platforms to work together. Even more time will be required before the service offerings of national administrations will be able to interwork.

Development of international standards is critical to ensure full utilization is made of the existing switch infrastructures and to exploit the many opportunities to support communications users on an international network basis. Both Telecom Australia and Northern Telecom are active now, and will continue to be active in key international standards forums.

Revolutionizing The Desktop
With Satellite Solutions

by
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Telesat
Ottawa, Ontario
Canada

ABSTRACT

Over the past ten years corporations have become increasingly more dependent on data telecommunications systems. Information networks are getting larger, faster, and more complex, and increasingly greater demands on these networks are being made. The demands corporations around the world are making of their information networks are causing a revolution in corporate workstations, and adapting to this desktop revolution will be critical to every company's success.

This paper will look at the satellite solution to the information management problem, and how it can be adapted to the needs and necessities of different companies.

INTRODUCTION

Over the past ten years corporations have become increasingly more dependent on data telecommunications systems. Information networks are getting larger, faster, and more complex, and increasingly greater demands on these networks are being made. This trend will continue into the 1990s as we see more automatic banking, more data processing applications, more centralized billing, and more point-of-sale applications.

The demands corporations around the world are making of their information networks are causing a revolution in corporate workstations, and adapting to this desktop revolution will be critical to every company's success. Assessing the needs and necessities for each application, and managing the flow of information to the desktop will be the key. One of the most effective solutions to the information management problem is provided by local area and wide area networks, and many companies have found that a cost-effective and cost-efficient way of managing data information using these networks is by satellite.

Satellite offers an alternative solution to the telecommunications management problem, either as a complete network, or as part of a communications mix which includes current terrestrial components.

In this paper I will look at the satellite solution and how it can be adapted to the needs and necessities of different companies. To do that, I will take a brief look at why satellite is becoming more accepted by telecom managers, by first taking a look at what is important to telecom managers. I will then examine how satellite fits into that list of priorities, and the strengths of the satellite alternative. Finally, I will take a close look at Telesat's own integrated corporate network as an example of how all these theories are being put into practice.

WHAT IS IMPORTANT?

In 1989, Telesat commissioned a study by Netmap, a Montreal-based research firm, and by Canadian Facts. Among other things, the objectives of that survey were to ascertain the market's attitude towards different transmission technologies, and satellite services in Canada. The survey results were analyzed by our own research department, and some important facts about the market's perceptions about the different technologies were revealed. One of the things that we found extremely informative is the different level of importance placed on specific service attributes by telecommunications users (Figure 1).

According to our analysis, the single most important attribute is service reliability, with an average rating of 9.27 on a value scale from 1 to 10. The second most important attribute is quality and clarity of transmission, with an average rating of 8.94. Accuracy of transmission came in third with 8.91, speed of repairs came in fourth with 8.70, and cost of service came in fifth with 8.44.

The results show that the top five service attributes for telecom managers are, reliability, quality, clarity, accuracy, and price. So where does satellite fit in?

WHERE SATELLITE FITS IN

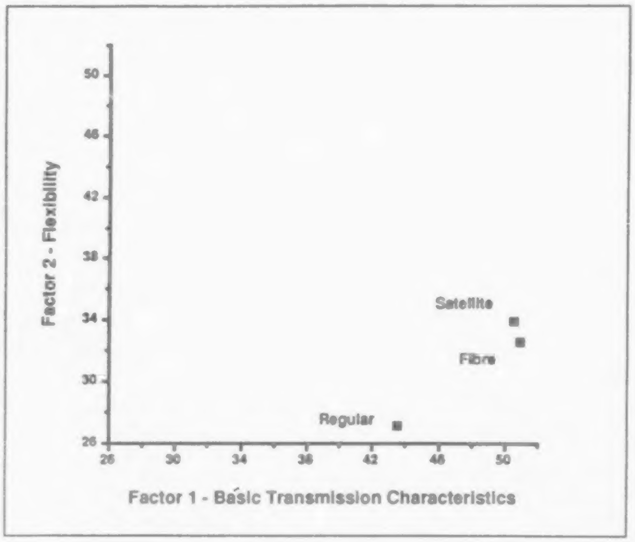
This same survey asked respondents to compare satellite transmission to regular terrestrial service and fibre optic

LEVEL OF IMPORTANCE OF SERVICE ATTRIBUTES

ATTRIBUTES	X
Service Reliability	9.27
Quality/Clarity of Transmission	8.94
Accuracy of Transmission	8.91
Speed of Repairs	8.70
Cost of Service	8.44

FIGURE 1

Comparison of Transmission Technologies



Basic Transmission Characteristics include:

- Accuracy of Transmission
- Quality/Clarity of Transmission
- Service Reliability
- Ability to Diagnose Problems
- Speed of Installation
- Speed of Repairs
- Security of Transmission
- Consistency of Service Throughout Network

Flexibility includes:

- Availability of Range of Speeds
- Ability to Change Speed or Bandwidth Allocation
- Ease of Adding/Changing Sites

FIGURE 2

offerings (Figure 2). Both satellite and fibre optic transmissions are perceived as improvements over regular terrestrial transmissions, and each are perceived as being superior in their own areas.

Fibre is perceived as being slightly superior in basic transmission characteristics. These characteristics include accuracy of transmission, quality or clarity, service reliability, and others. Satellite is perceived as being superior in terms of service flexibility characteristics. These include availability of range of speeds, the ability to change speed or bandwidth allocation, and the ease of adding or changing sites. And satellite services also score highest in four categories: speed of repairs, consistency of service throughout the network, the ability to diagnose problems, and cost of service.

For Telesat, the survey analysis confirms what we've been saying about satellite services since we first entered the telecommunications market seventeen years ago. The key words used to describe satellite services are flexibility, cost, and consistency. And each of these words has a specific meaning to telecommunications managers when referring to satellite services.

Flexibility means that because of the relative simplicity of a satellite communications system, communications links can be established virtually anywhere quickly and with a minimum of effort. Locations can be added, moved or up-graded as needs change, and a satellite system is flexible enough to allow existing terrestrial locations and equipment to be integrated with a satellite network.

In terms of cost, satellite service is generally more cost-efficient than other network alternatives. Advances in technology have brought down the size and cost of satellite earth stations so that satellite communications is now an option for all companies, and with the advent of teleports, earth station costs can be spread among several customers. That makes satellite communications more economically attractive than their terrestrial counterparts.

Private satellite networks are also inherently more efficient than other network alternatives because a single satellite channel can accommodate voice, data, or video communications between any combination of sites within a network.

For example, satellite capacity can be used for a conversation between Toronto and Montreal one minute, and then that same channel can be re-used for a conversation between two other cities. To do the same with a terrestrial network would require a separate line for each connection, a line which might often be left idle. But with satellite, the cost of this excess capacity can be avoided.

The satellite alternative also offers further cost advantages because communications costs are based on distance insensitive prices. This means that in a satellite network, it would cost no more to send a data file to two cities in different time zones, than it would to send the same file to two cities in the same time zone.

But the flexibility and cost-efficiency of satellite communications networks does not mean that the consistency of service is compromised. The very nature of satellite communications ensures that each site in a network, no matter how remote, receives the same consistent, high quality digital signal. That's because a satellite signal is transmitted once up to the satellite from its point of origin, and then only once to any number of sites across the country. And this inherent flexibility and simplicity virtually guarantees consistency because there is less that can go wrong. That's important, because to succeed in today's market, every business must be able to depend on its network at all times.

THEORY INTO PRACTICE

Because satellite telecommunications offers these distinct advantages, many Canadian organizations have already opted for the satellite solution. Telesat has also put all this theory into practice. The knowledge and expertise we have gained has been applied in our own corporate network which combines terrestrial components with satellite components. We still use some services provided by other telecommunications carriers because there are things they do very well. But we know that with satellite we can improve the speed, efficiency, cost, and productivity of many aspects of our network. The result is an integration of satellite-based systems with the best capabilities of terrestrial systems.

Our corporate network uses satellite links, terrestrial microwave links, packet radio, and VSAT technology to connect all our offices. More than a dozen Telesat offices are connected across the country. Satellite is the backbone of the network, and the result is what we call SWAN--the Satellite Wide Area Network.

What we've learned from our own integrated corporate network is which applications work best on each different type of link, and which don't. Using these technologies on a daily basis gives us experience with them, and allows us to learn the pros and cons of each, and in which cases it's best to apply them.

An example of this at work is our Electronic Mail system, controlled through our corporate Mac computer network. In 1988 we had approximately 20 users on this network. Within 18 months Telesat experienced an information management revolution and that number exploded to 800 users.

Each Telesat regional office is connected through our corporate computer network, and each department in headquarters is also connected. Through our E-mail system, each user has access to everyone else in the network, individually under personal names, or as a group under department names. And because of this mesh connectivity, where everyone has access to everyone else, we can make a few calculations and estimate that, on average, the number of messages being exchanged on the corporate network can be as high as 40,000 per day. That's an average of 53 messages per capita, per day. Clear and efficient batch data communications over satellite controlled from 800 desktops every hour of every day.

During the past eighteen months, this E-mail application has become the most important element of the corporate network. It is the lifeline of the company, and it has revolutionized our internal communications. But there are other applications that also work extremely well. These include word processing, spreadsheets, graphics, and database management systems. And as an added benefit, documents produced in any of these applications can be forwarded to any number of employees anywhere in the company through our E-mail system.

The whole network works extremely well, and we have learned how to adjust it to suit our needs. This desktop information management revolution has also changed the way we approach potential customers. In the future we will be looking at ways to integrate our suppliers and our customers into this communications lifeline, by assessing their needs and selling them a desktop application to fulfill those needs, rather than just a communications pipe on which to communicate.

We want our customers to benefit from our experience with the information management solutions we have developed on our SWAN. There are two ways we can do that. First by providing direct communications to each corporate desktop via a complete E-mail system which would include the computers and the delivery and receive system. And secondly, by providing direct access to a centralized database from remote regions with a Satellite Wide Area Network.

But our E-mail application is just the tip of the iceberg. Our internal computer communications specialists, and our software suppliers are looking at implementing new technology solutions to further improve business communications. One of the areas currently under development is the evolution of E-mail to the next logical step. That step is the desktop transition of data messages into voice annotated messages on the E-mail network.

Another area we are experimenting with is videoconferencing capabilities controlled by employees from desk computers. And finally, we are looking at the possibilities of a shared visual space application which would allow two or more people in different locations to work on the same document at the same time.

What will continue to be important in the ability to control and manage all these applications are flexibility, consistency, and cost of the transmission medium. And that's where satellite shines. For companies assessing their communications needs and requirements in the ever expanding global economy, it is often the best solution.

Entrance into World Telecommunication Service Markets; Deregulation, Competitive trends, and Privatization - Influence on the North American Sector.

Mr. Laurence J.E. Dunbar, Johnston & Buchan, Ottawa, Canada
Ms. Gail E. Granton, InterCommunications, USA
Mr. Howard A. Neckowitz, InterCommunications, USA

1. ABSTRACT

Experience in North America indicates that once limited competition in telecommunications services is permitted through "enhanced" service providers and "sharing groups", a natural evolution towards a fully competitive domestic industry structure is set in motion. North American experience may be expected to be repeated in other countries where limited competition in domestic service markets is now being introduced. Knowledge of this evolutionary process affects the price that private investors are willing to pay for PTT's that are now being privatized. It will also ultimately serve to lower accounting rates payable by foreign carriers to terminate traffic in those countries.

2. A SCENARIO FOR THE EVOLUTION OF FULL TELECOMMUNICATIONS SERVICES COMPETITION

Experience in countries which have permitted competition in domestic telecommunications markets provides a useful picture of what might be expected to happen in other countries that are considering the restructuring of their telecommunications markets and the introduction of varying levels of competition. While legislative and regulatory limitations on competition have varied from country to country, these restrictions have been eroded over time as service providers within those markets have sought to fully utilize the technology at their disposal to compete with the established carrier or carriers.

While governments or regulators might seek to impose limitations on the extent of competition in domestic markets in an effort to maximize the sale price of government owned PTT's, to protect established carriers, to protect existing rate structures or advance other policy objectives, experience in North America indicates that once a decision is taken to introduce competition in specialized service markets, a fairly predictable chain of events is likely to be set off - ultimately leading to broad-based competition in which the distinctions between service providers and facilities-based carriers is blurred. This has important implications in countries like Australia, where the government is "guaranteeing" the purchaser of AUSSAT a duopoly until mid-1997, while at the same time lifting all restrictions on resale of domestic and international telecommunications. Experience elsewhere indicates that the value of this "duopoly" may be affected by the advent of resale competition.

From a historic perspective, the development of competition in telecommunication services can be summarized in four evolutionary plateaus. However, in each market significant variations will be experienced in the speed with which competitive markets move. Timing depends on interrelated factors including the state of the political arena, privatization if any, quality of service currently provided, and the influence of the dominant carrier. The four plateaus are:

Proliferation of private networks through traditional facility based carriers. Private customers lease bulk capacity from existing facility based carriers, normally the existing dominant telecommunication provider(s), and package intercity and local services to arbitrage bulk DS-1 capacity rates. At this stage, based on limited competitors providing backbone facilities and the resulting high pricing for bulk capacity leases (i.e., high break even points of voice grade to DS-1), there is limited development in private networks beyond large corporate users who often aggregate their traffic on shared networks.

Development of alternative facility based carriers. Utilizing right-of-way opportunities, either through their control, lease, direct ownership, strategic alliance or through joint venture, other alternative facility based carriers emerge to provide competition in the intracity and intercity facility market. At this stage, it is common to see development of teleports and alternative local intracity fiber and limited digital radio providers often termed by the local dominant carriers as "local-bypass carriers". Additionally, at this stage long-haul intercity facility based carriers emerge, building fiber where rights-of-way can be obtained. Joint ventures involving railroads, gas companies or other utilities, cable television, and public transport systems become quite commonplace. Sometimes these right-of-way holders themselves have limited corporate networks already in place for internal use. This is often the case with the railroads for example. These alternative facility based systems often start out as private networks providing restoral and redundancy for existing systems. They later seek to use these facilities to provide services to the public and apply for local interconnection in order to do so. They ultimately provide the basis for increased facility based competition and the potential for DS-1, DS-3 arbitrage required for the emergence of a viable resale and sharing environment.

Alternative service development through resale and sharing of "enhanced services". As technology continues to progress rapidly, additional suppliers of value added services continue to emerge. Often primarily focused on the data market, these value added providers seek opportunities to expand their service portfolios. At the same time, other new entrants to the resale and sharing marketplace focus on the voice and facsimile market offering customized billing packages and facsimile services to business users. This transition towards services that might be considered "basic" provokes protracted regulatory disputes as to what is defined as an enhanced services, and therefore allowed interconnection to the local network. These proceedings often involve disputes over denial of access by the dominant carrier, quality of access available, and the impact of resale competition on local rate structures.

Competition in "basic services" through the struggle for equal access and local interconnection. With additional facility providers emerging and the distinction between basic and enhanced resale and sharing disappearing, the focus is more clearly established on equal access to the local network. Technically the emerging alternative carriers require dialing plans from the local network provider that are transparent to their customers. Ideally, this involves equal access on a 1+ pre-selection basis. Casual calling access using a carrier prefix such as 10XXX is less desirable when used as an alternative dialing method since the customer must in effect, pre-select each call. At this stage, disputes arise over the availability of equal access, the cost of upgrading local switches to accommodate equal access, and access to billing and collection arrangements. In addition, new carriers seek alternative access arrangements including digital access trunks, the provision of ANI and CLID, and well defined points of interconnection with the local network.

3. DEVELOPMENT OF COMPETITIVE SERVICES IN CANADA; A CASE EXAMPLE

Canada provides an interesting example of a country that has embarked down the road toward a competitive telecommunications market in an incremental manner weighing the pros and cons of each progressive step along the way. Recent regulatory proceedings involving issues of resale and sharing illustrate the difficulties encountered by regulators when they attempt to limit the speed at which competition develops by imposing restrictions on resellers' activities. The Canadian experience in this regard appears to be following that of the United States where such restrictions have been eroded over time and the distinction between resellers and competing facilities-based carriers has largely disappeared.

The Canadian Radio-television and Telecommunications Commission (CRTC) regulates telecommunications at the federal level in Canada. This independent regulatory tribunal does not have a clear statutory mandate to favor either the monopoly or competitive provision of telecommunications services. It is however empowered to order interconnection between carriers and to ensure that the carriers it regulates do not discriminate unjustly against any person or grant any undue preferences of advantages. This latter provision has been interpreted by the courts to preclude carriers from granting themselves undue preferences and has formed the basis for several decisions expanding access to network facilities by competing service providers.

In considering whether to expand the range of permissible competition, the CRTC employs a public interest test which gives it latitude to consider the impact of competition on all relevant sectors weighing any benefits and detriments identified.

As with most contentious regulatory policies, the debate over resale and sharing of telecommunications services involves an attempt by the regulator to balance a number of competing policies and interests. These include a desire on the part of business in general, and particularly of small business, for lower long distance rates and access to more varied and enhanced telecommunications services; a commitment on the part of the government to stimulate innovation in the Canadian telecommunications service sector and to develop a healthy competitive market for telecommunications service providers; and a concern on the part of governments, regulators, and consumer groups about undermining the existing telephone rate structure in a manner that might cause local telephone rates to increase significantly and threaten the universal availability of telephone service.

3.1 ENHANCED SERVICES REGIME

Prior to 1984, resale and sharing of telecommunications services was generally precluded in Canada by the terms of the telephone companies' general tariffs. In the early 1980's the merging of computer processing and telecommunications technology led to the development of new enhanced telecommunications services which both the telephone companies and other service providers were interested in offering to the public.

Following applications by Bell Canada, BC Tel, and Unitel to provide a number of enhanced services in 1981, and the CRTC's subsequent approval of these applications on an interim basis, the CRTC convened a public proceeding in November, 1983 to consider more generally the regulatory framework for the provision of these new services by the carriers and other service providers.

In its decision, the CRTC endorsed the desirability of permitting competition in the provision of enhanced services and expressed the view that its decision should allow the provision of a wide range of services on a competitive basis (Telecom Decision 84-18).

In distinguishing between enhanced services and basic services, the Commission adopted essentially the same definitions as had been adopted earlier by the Federal Communications Commission (FCC) in the United States in its Second Computer Inquiry, 77 FCC (2d) 384 (1980).

In its decision, the CRTC also addressed the need to relax the rules governing resale and sharing of telecommunications services. The CRTC recognized that common carrier services generally underlie enhanced services and concluded that resale of carrier services is required for competition to develop in the enhanced service market and that such resale should generally be permitted.

In order to guard against the possibility of a service provider making marginal enhancements to a basic service in order to operate as a general reseller of long distance voice services, the CRTC placed a restriction on resale activity. It decided that resale of all carrier services, including basic services, should be allowed provision of enhanced services, unless the enhanced service has as its "primary function" the provision of a basic service.

Subject to these rules, the CRTC decided not to regulate service providers engaged in the provision of enhanced services. It decided to continue to regulate facilities-based carriers providing enhanced services on an in-house basis, but not to regulate them when such services are furnished out of a separate arms-length affiliate of the carrier.

The CRTC's Enhanced Services Decision attempted to steer a course that would encourage the competitive development of enhanced services with minimal impact on the telephone companies' long distance revenues. In order to qualify as an enhanced service provider, and be permitted to resell underlying telecommunications services, a service provider had to demonstrate (1) that the service in question met the technical tests of enhancement; and (2) that it did not have "as its primary function, the provision of a basic service".
service".

These definitions and tests proved to be a regulatory mine field for some service providers, whose services were challenged before the CRTC following introduction of this regime. In particular, it became clear that the "primary function" test was too subjective to provide any real guidance to entrepreneurs wishing to enter the enhanced services market. Ultimately, following protracted regulatory proceedings involving Call-Net Telecommunications Ltd. (Call-Net), the CRTC decided in Telecom Decision 88-11 in August, 1988 to abandon its special regime governing resale for the provision of enhanced services in favor of more generic rules governing resale and sharing activity, which it had by then developed in Telecom Decision 85-19 and 87-2.

3.2 The Call-Net Proceedings

Call-Net commenced business in 1986 with a plan to provide Call Detail Account Recording (CDAR) service to business users as an enhanced telecommunications service.

CDAR service is a telephone management and accounting tool for business users which requires telephone users to "tag" all outgoing long distance calls with accounting information relating to the client or project or department in the subscriber's business to which the charge should be billed or accounted for. It was Call-Net's plan to centrally provision this service through use of its digital switches which would collect all billing data. Call-Net would then process the accounting data and provide its customer with bi-monthly reports with all of the customer's call and charges itemized in accordance with the customer's own system of accounts. By centrally provisioning the service, Call-Net made it available to smaller businesses without the need for them to own any specialized terminal or switching equipment.

Call-Net set up this network using interconnected private line services and WATS services acquired from the telephone companies and Unitel - a specialized interexchange carrier.

Bell Canada immediately challenged Call-Net's status as an enhanced service provider by refusing to provide the company with facilities in October, 1986. This precipitated protracted regulatory proceedings which went on for almost four years before the CRTC, the Federal Court of Canada, and on petition before the Federal Cabinet.

In Telecom Decision 87-5 on May 22, 1987 the CRTC ruled Call-Net's CDAR service was not enhanced, and that even if it was enhanced, it had as its primary function the provision of a basic service similar to message toll service (MTS). The CRTC equated CDAR service with MTS billing and did not consider that the additional accounting features altered this characterization. The Commission also considered that the CDAR functions were "external" to Call-Net's network.

Although the CRTC ruled against Call-Net, Call-Net obtained a stay of the disconnection order pending appeal of the decision and managed to stay in business until an appeal to the CRTC was heard. Following another negative ruling by the CRTC, Call-Net petitioned the Federal Cabinet which has authority to review and vary CRTC decisions. While the Cabinet refused to reverse the CRTC, it did extend the stay of the CRTC's disconnection order to give Call-Net time to restructure its services in order to comply with the regulatory regime. Call-Net used this time to develop additional services which it hoped would qualify as "enhanced". Call-Net then launched a new proceeding before the CRTC asking the regulator to liberalize its resale rules and permit Call-Net to offer its services to the public. In August, 1988, the CRTC again denied Call-Net's application.

3.3 RESALE AND SHARING REGIME

In Telecom Decision 85-19 the CRTC had decided to permit limited resale and sharing activity beyond what it had permitted in respect of enhanced services.

The CRTC weighted the advantages and disadvantages of allowing resale and sharing. It summarized the advantages in the following way:

> The Commission considers that, with respect to resale and sharing, users would benefit from an increase in the number of suppliers through improvements in supplier responsiveness and a stimulation of service innovation. Resale and sharing would spread the benefits of competition through the market more quickly than would facilities based competition and, initially at least, these benefits would be available to a larger number of smaller users. Further, permitting expanded resale and sharing would remove some of the uncertainty in the provision of enhanced services in those cases where it may be difficult to determine the primary function of an enhanced service. (Telecom Decision 85-19 at p. 83)

On the negative side, the CRTC considered the potential for uneconomic entry by resellers based on artificial rate differentials between bulk services and MTS service, and the potential for erosion of the carriers' revenues and the existing rate structure with its built-in cross-subsidies for access service.

In weighing these advantages and disadvantages, the CRTC decided not to allow forms of resale that would permit resellers to offer discounted MTS-like services. It felt that to allow this type of resale activity under the existing tariff structure would be unfair to the telephone companies and result in significant revenue erosion, thereby putting upward pressure on local rates. The CRTC did, however, decide to allow resale and sharing for the provision of non-MTS/WATS interexchange services and for the provision of local services, on an unregulated basis.

It then took until 1987 to translate this philosophy into a series of regulations in Telecom Decision CRTC 87-2. These regulations permitted unrestricted resale and sharing for the provision of data services and restricted resale and sharing for the provision of voice services.

The rules were further complicated by the CRTC's desire to accommodate "sharing groups" - some of which had come into existence prior to the CRTC's decision on resale and sharing. These sharing groups had been formed by a limited number of businesses to share private line facilities between Canadian cities. One of these groups - Canada Systems Group - had already established a national network to satisfy its members' communications needs.

In Telecom Decision 87-2, the CRTC decided to draw a distinction between "sharing" and "resale" and to permit the sharing of interconnected private line services, including digital facilities for the provision of voice services. Sharing groups were required to contract directly with the carriers for services, and each member had to agree to be jointly and severally liable for any charges incurred. Resellers on the other hand, were not allowed to aggregate traffic for transmission on interconnected private lines. They were restricted to reselling individual circuits to individual users for the provision of voice services.

It did not take long before this distinction was tested in proceedings before the CRTC and the courts. Once again, the proceeding involved Call-Net - the company that had failed to satisfy the "enhanced services regime" with its CDAR service. Following its unsuccessful appeal of the CRTC's rulings under the enhanced services rules, Call-Net had reconstituted its former customer base as a sharing group which Call-Net managed as the members' agent. This new arrangement was immediately challenged by Bell Canada which alleged that the operation remained a resale operation outside the scope of the CRTC's rules.

At the heart of the dispute was Call-Net's role as the agent/administrator of the sharing group, and a provision in the group's constitution which required Call-Net to obtain insurance on the member's behalf to minimize their risk of liability to Bell Canada resulting from their joint and several liability for all underlying services acquired from the carrier.

In Telecom Letter Decision 88-9 in September, 1989 the CRTC again ruled against Call-Net stating that the reason for requiring joint and several liability was to preclude resellers from organizing their customers into sharing groups. The Commission considered that by insuring against their contractual liability to the carriers, this provision had been circumvented.

Following release of this decision, Bell Canada disconnected Call-Net's interexchange facilities. Call-Net appealed the CRTC's decision to the Federal Court of Appeal alleging, inter alia, that the CRTC had erred in law by finding Call-Net to be engaged in continued resale activity, and by misconstruing the effect of insurance on the contractual obligation for joint and several liability. The Federal Court of Appeal, however, found no error of law or jurisdiction and leave to appeal to the Supreme Court of Canada was denied.

During these judicial proceedings, Call-Net also petitioned the Federal Cabinet to vary Telecom Letter Decision CRTC 88-9 to require Bell Canada to provide the sharing group with facilities pending final disposition of Call-Net's judicial appeal. This order was granted on October 17, 1988 and permitted Call-Net to stay in business until all of its appeal avenues had been exhausted.

Following these protracted proceedings dealing first with the restrictions contained in the enhanced services decision, and then with the distinction between reselling and sharing, the CRTC decided to convene a new proceeding in January of 1989 to reassess its rules governing the resale and sharing of private line facilities. That proceeding culminated in Telecom Decision 90-3 in March of 1990 - a decision in which the Commission abandoned its distinction between resellers and sharing groups and permitted both types of operation to resell private line facilities on the same terms and conditions. Resale and sharing of WATS, however, continued to be prohibited.

This decision, which was implemented on May 29, 1990, has precipitated a high degree of activity in the Canadian telecommunications market. It has also given rise to new demands by resellers for improved access arrangements. Digital access trunks are now being made available to link the resellers' central office equipment with that of the telephone companies. Access to automatic number identification (ANI) and answer supervision is also being pursued. Nor have resellers confined their attention to domestic markets. They have established interconnection arrangements with U.S. carriers and pursued similar arrangements with Canada's overseas telecommunications carrier - Teleglobe Canada. In Telecom Decision 90-19 in September 1990, following applications by two resellers, the CRTC ordered Teleglobe Canada to provide direct connection to resellers' circuits and to file new tariffs for the resellers which exclude the portion of their rates currently payable to Canadian domestic carriers for origination of overseas traffic.

Resale of WATS has also been made an issue by the CRTC in its upcoming public hearing to consider applications by Unitel Communications Inc. and a consortium known as BC Rail/Lightel to provide competitive MTS/WATS services in Canada.

This application by BC Rail/Lightel takes the resale issue one step further in Canada since that consortium plans to use a combination of its own facilities and resale of other carriers' facilities to provide its long distance services to the public. This hybrid carrier is similar to what has evolved in the United States, starting initially with MCI Communications Inc. BC Rail/Lightel will now force the CRTC to consider whether hybrid carriers should be treated like resellers or like the competing interexchange carriers in terms of quality of access, contribution to local service costs, and service obligations. BC Rail/Lightel has asked for equal access arrangements and CCS7 interconnection, but has proposed to pay the relatively low level of contribution to local access costs that is currently payable by resellers. The question now arises whether the regulatory regime can sustain the distinction between resellers and carriers, when resellers are acquiring more and more of the indicia of carriers, and when hybrid reseller/carriers are being formed.

4. THE QUANDARY OF PRIVATIZATION; SETTING A HIGH PRICE FOR NATIONAL CARRIER SYSTEMS WHILE BALANCING THE NEED FOR COMPETITION

The trend toward privatization of government owned telecommunications monopolies has provided numerous investment opportunities for North American carriers, particularly U.S. Local Exchange Carriers and other foreign telecommunications carriers with expertise in managing and operating local service networks. However, the very competitive market that allows these carriers to invest in foreign telecommunication markets may provide the impetus for the development of competitive service environments which may undermine this investment.

Three key goals of foreign governments in privatizing PTT's are to obtain a significant price and return to the national economy for the national network, to improve the operation and quality of services, and to create an environment where technological advances are more quickly brought to the marketplace. However, often the benefits of competition - lower rates, carrier selection, and service innovation - are also desired.

Foreign governments desire to maximize the valuation of the national network. However, potential investors must understand and fully evaluate the dynamics of the market they are buying into. In order to achieve a high value for the network and concession, foreign governments may provide specific or non-specific limitations on the introduction of competition in the marketplace. For instance recently Mexico and Australia have provided as a condition of the sale of their national networks that equal access will not be provided to competitors for six and seven years respectively. However, the limitations are unclear regarding the speed of development of alternative intracity and intercity facility based carriers for use with private networks and resale and sharing. A buyer is thus placed in the difficult position of evaluating the impact of limited levels of competition on the value of the national network.

The example of the development of competition in North America will influence others seeking to set up alternate networks in deregulated world markets. Once service competition is allowed, a natural evolution toward a fully competitive environment is set in motion.

5. INFLUENCE OF COMPETITIVE AND NON-COMPETITIVE WORLDMARKETS ON THE FINANCIAL VIABILITY OF U.S. INTERNATIONAL SERVICES; THE USE OF TRADITIONAL SETTLEMENT AND ACCOUNTING PROCEDURES IN A MIXED COMPETITIVE CLIMATE.

5.1 THE U.S. NET SETTLEMENT DEFICIT

An example of the strong influence foreign telecommunications administrations management and operational policies can have on other foreign operating carriers is evidenced by the current situation facing U.S. carriers and consumers with the excessive net settlement deficit paid out to foreign administrations partners. The importance of this situation is such that the FCC is studying the matter and in July, 1990 published a Notice of Proposed Rulemaking to solicit comments on the goal to decrease the U.S. net settlement deficit.

Significant factors contributing to the U.S. net settlement balance include the access to competitive terminating rates in the U.S., the fact that the overall balance of traffic is in favor of other countries, and foreign national interests and telecommunications policies generally conflict with the policy of lowering international accounting rates.

The international telephone settlement process is theoretically intended to ensure adequate compensation of the correspondents in a joint service arrangement for the cost of providing service. Accounting rates were initially set to reflect the cost of service including a rate of return. Under such a scenario, a correspondent generating more traffic to its partner would not necessarily be financially penalized as the division of the accounting rate would cover the cost.

In comparison with many foreign correspondent telecommunications markets, the U.S. represents a highly competitive and less regulated market. The provision of telecommunication services in other countries is for the most part still strictly regulated with limited competition. Service is usually provided by a monopoly government owned and operated carrier. This difference in telecom policy has resulted in low terminating rates within the competitive U.S. market and high terminating rates in many other countries under a monopoly regime.

Foreign correspondents seeking to lower their terminating cost for at least a portion of their traffic are in a position to take advantage of the U.S. competitive domestic market to obtain highly discounted rates for termination of traffic in the U.S. on a switched private line basis. These arrangements are typically on a one-way basis without reciprocal rates for termination of U.S. traffic by the foreign correspondent.

With the entrance of competitors in the U.S. IMTS market, IMTS rates declined, traffic was stimulated, and the U.S. competitive market continued to experience high growth levels. Accounting rates did not decline in parity with U.S. collection rates nor did foreign correspondent traffic levels grow at the same rate as U.S. traffic. As a result, under the traditional settlement structure the U.S. net settlement deficit for International Message Toll Service (IMTS) grew to its current level of approximately $2 billion dollars per year.

The U.S. generates more minutes of outgoing telephone traffic currently at a level of approximately two minutes of U.S. generated outgoing traffic for each minute of return inbound traffic. The gap in the traffic imbalance has continued to increase with U.S. carrier competitive rates and targeted marketing toward international calling resulting in stimulation of U.S. originating traffic. Other factors contributing to the imbalance include the higher cost of international calling in foreign countries, disparity in levels of income, ease of telephone access, differences in the direction of trade, and U.S. involvement in particular countries (e.g., where large concentrations of U.S. military forces are located).

In many countries high international rates have been used to subsidize the cost of local service and universal service provision. An imbalanced traffic stream with artificially high accounting rates in effect provides another source of income PTTs may rely on for subsidization of local telecommunication services. With the movement toward privatization of telecommunications administrations in many countries, radical changes in accounting policies are likely to meet strong resistance. High international revenues provides a major contribution to the profitability of these administrations and any attempt to lower international rates and accounting rates may adversely affect valuation.

The North American sector provides an example of how the very different telecommunications environments existing in Canada and Mexico have both worked to influence the provision of transborder services by U.S. carriers.

5.2 ACCOUNTING RATES IN A SEMI-COMPETITIVE ENVIRONMENT - CANADA

Canada was one of the first international markets in which U.S. competitive carriers sought direct interconnection with domestic carriers. The slow development of competition on the Canadian side of the border served to delay the reduction of accounting rates, limiting the ability of U.S. carriers who had started to provide service on a one-way basis with Telecom Canada to reduce rates beyond a certain level. When MCI and U.S. Sprint finally obtained two-way agreements with Telecom Canada, the lack of strong competitive pressure on Telecom Canada effectively limited the openness of the two-way U.S. - Canada marketplace to the largest U.S. carriers who were required to pay what amounted to an agreement entrance fee to Telecom Canada.

Canada's limited competitive market directly influenced the ability of other U.S. carriers to compete in this market. The history of U.S. - Canada settlements provides an example of the manner in which competition on international routes leads to lower accounting rates that are more in line with the cost of service.

While the members of Telecom Canada still enjoy a monopoly over the provision of MTS/WATS services in Canada, the emergence of MCI and U.S. Sprint on the international scene, coupled with relaxation of rules restricting resale activity on Canada - U.S. and domestic Canada routes, has led to downward pressure on rates for Canada - U.S. service and consequently downward pressure on the international settlement rate.

In April 1987, Telecom Canada entered into traffic settlement arrangements with both MCI and U.S. Sprint providing for proportional return traffic for these carriers. This broke a long standing monopoly on Canada - U.S. routes enjoyed by Telecom Canada and AT&T. While Telecom Canada decided to treat competing U.S. carriers on an equal basis (provided they had a certain threshold of traffic), this did not in itself result in lower settlement rates. As long as Telecom Canada enjoyed a monopoly on the termination of U.S. - Canada traffic it had no particular incentive to drop its rates for Canada - U.S. calls or lower the accounting rate.

In 1987, the CRTC began to liberalize restrictions on the resale of private line facilities both within Canada and on Canada - U.S. routes. Resellers in Canada began offering direct access to the networks of U.S. carriers at points just across the U.S. border. Also in 1987, the CRTC permitted United Communications, Inc. (formerly CNCP Telecommunications) to connect its broadband exchange network in Canada to Western Union's network in the U.S., providing universal termination in the U.S. for Unitel's Canadian broadband customers. This competition on southbound routes had a dramatic impact on the price of Canada - U.S. calls. Unitel and the resellers offered a substantial discount off Telecom Canada's established rates through AT&T, MCI, and U.S. Sprint.

Telecom Canada responded with its own discount services called "Advantage U.S." - a subscription service with volume related discounts. It also began lowering its basic rates for Canada - U.S. MTS/WATS services under pressure from Canadian business groups. However, the activity was all on southbound traffic. Telecom Canada still enjoyed a monopoly on the termination of northbound MTS/WATS traffic due to regulatory restrictions on the termination of switched voice service in Canada.

This policy was tested in 1989 by Unitel and Allnet Communication Services, Inc. The CRTC refused to allow Unitel to terminate Allnet's virtual private line traffic in Canada on the basis that it was a switched service.

This regulatory regime changed again in May, 1990 when further liberalization of domestic Canadian resale rules was implemented. The new rules permit resellers to originate and terminate switched traffic in Canada, including international traffic with the U.S. The new regime has opened the door for both resellers and carriers to directly access the Canadian or U.S. markets, bypassing traditional settlement arrangements. Large digital facilities are being used to connect the networks on both sides of the border. This activity is not limited to Canadian resellers. There are no foreign ownership restrictions on U.S. resellers operating in Canada. For example, AT&T is actively marketing its Globecom service in a number of Canadian cities. Other U.S. carriers are leasing Canadian facilities to originate or terminate traffic in Canada.

Introduction of this limited competition in the Canadian domestic market, coupled with a concerted effort by both the CRTC and Telecom Canada to reduce MTS/WATS rates, has led to a dramatic drop in rates for transborder U.S. - Canada services and is precipitating a corresponding drop in the accounting rates. It is our understanding that the carriers are now poised to drop the rates to 14 cents/12 cents from the current 21 cents/19 cents peak/off-peak rate.

5.3 ACCOUNTING RATES IN A NON-COMPETITIVE ENVIRONMENT - MEXICO, A TWO-PART PROBLEM

Like Canada, the policies for telecommunications service provision in Mexico have had great influence on the U.S. marketplace on a variety of levels, from limiting the ability of U.S. competitive carriers to effectively reduce rates on the route, to contributing to the overall U.S. net foreign trade deficit.

Transborder U.S. - Mexico toll services with the non-competitive environment in Mexico and the competitive environment in the United States produced a cumulative net deficit of over $1.2 billion dollars for the period 1985-1988.

This net deficit is caused by two factors. Based on the combination of high customer rates in Mexico and a lower income level in Mexico, traffic between the U.S. and Mexico is highly imbalanced with approximately two minutes of traffic going from the U.S. to Mexico for every one minute of traffic from Mexico to the U.S. The effect of this imbalance of traffic is exacerbated by a historic settlement mechanism which pays TelMex for termination of traffic in Mexico approximately three to four times the settlement per minute that TelMex pays for termination in the U.S.

It is recognized that Mexico currently is undertaking an extensive network modernization program and is in the process of rebalancing its product lines, including recent movements in reducing U.S. - Mexico rates and settlements. Mexico has recently made a ten year commitment to reduce accounting rates on the route. However, while we recognize this as a major step toward reduction of the deficit, further concessions are required by Mexico if the net settlement balance is to be significantly reduced. Unless the U.S.-Mexico accounting method is changed, it is expected that with highly competitive terminating rates in the U.S., Mexico will aggressively pressure U.S. competitive carriers to lower northbound U.S. terminating settlement rates still further. Based on the lack of competition in Mexico, it is highly unlikely that corresponding decreases in southbound settlement rates will be negotiable, and the U.S. net settlement deficit between the U.S. and Mexico will likely increase.

The effect of the impending privatization of TelMex on the net settlement problem is uncertain. Balancing the desire of the Mexican government to set a high valuation for its national network and need for modernization of the network, against the benefits of competition is a thin and as yet, undetermined line. The telecommunications policies of Mexico will continue to strongly influence the United States telecommunication environment. It is likely that a U.S. carrier(s) will make significant financial investments in TelMex. In order to protect its investment, that carrier will naturally encourage the limitation of competition. On the other hand, political pressures on Mexico in the context of negotiation of a Free Trade Agreement may produce an opening up of the Mexico telecommunications market and downward pressure on settlement rates and a corresponding reduction in transborder rate.

6. CONCLUSION

Experience in North America indicates that once limited competition in telecommunications services is permitted, a natural evolution towards a fully competitive domestic industry structure is set in motion. This typically follows a pattern involving the formation of shared user networks by large businesses using carrier-provided facilities; the introduction of limited facilities-based competition by utility companies, railways or others with private networks and access to rights-of-way, the introduction of service competition by resellers and enhanced service providers, and the pursuit of superior access to the local exchange network by all of these constituencies. While legislative and regulatory limitations on competition have varied from country to country, these restrictions have been eroded over time as service providers and specialized carriers within those markets have sought to fully utilize the technology at their disposal to compete with the established carrier or carriers.

This evolution has important implications for the industry restructuring and privatization process that is underway in an increasing number of domestic telecommunications markets. It also affects the rate structure of international telecommunications services.

Investors attempting to evaluate PTT's or other carriers being privatized or sold in foreign markets will have to consider the potential for the evolution of this form of competition - for example in such countries as Mexico and Australia.

While governments or regulators might seek to impose limitations on the extent of competition in domestic markets, in an effort to maximize the sale price of government owned PTT's, to protect established carriers, to protect existing rate structures or advance other policy objectives, experience in North America indicates that once a decision is taken to introduce competition in specialized service markets, a fairly predictable chain of events is likely to be set off - ultimately leading to broad-based competition in which the distinctions between service providers and carriers is blurred. This obviously has an impact on the value of the carrier being sold.

The introduction of domestic competition also has an important impact on accounting rates and settlements payable for terminating international telecommunications traffic. U.S. experience illustrates the imbalance of accounting rates that results in respect of traffic between monopoly markets and competitive markets. Once alternative means evolve for international carriers to terminate traffic in domestic markets, accounting rates become competitive and international rates may also be expected to fall.

TELEPORTS: GATEWAY TO GLOBAL CONNECTIVITY

ANAND KUMAR
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1. ABSTRACT

AS THE NEED FOR VARIOUS FORMS OF INTERNATIONAL COMMUNICATIONS AND ACCESS TO INFORMATIONAL DATA BASES GROWS AT A RAPID RATE, TELEPORTS - THE COMMUNICATION HUBS - PLAY AN EVER INCREASING ROLE IN MEDIATING THIS NEED. WHILE THE TECHNOLOGICAL, REGULATORY AND MARKET REALITIES IN THE INTERNATIONAL ARENA DICTATE THE SUCCESS OF NEW INFORMATION GATEWAY EVOLUTION, THERE ARE A NUMBER OF BASIC "DRIVING FORCES" THAT ARGUE FOR THE CREATION OF NEW "GLOBAL GATEWAYS" IN THE PACIFIC INFORMATION COMMUNITY. WE BELIEVE THAT THE HISTORICAL GROWTH AND THE INTERNATIONAL AND DOMESTIC SERVICE OPPORTUNITIES BEING EXPLORED BY WIT PROVIDE AN INTERESTING CASE STUDY THAT WILL ASSIST IN THE CREATION OF THESE TYPES OF TRANSMISSION NODES.

Unprecedented changes in the geopolitical landscape in various parts of the world are bringing the world closer together in terms of faster and more voluminous information exchanges. The elimination of political and trade barriers is guaranteed to release the pent up demand for establishing new information streams where none existed before. This demand for varied and enhanced communications link is being overlaid on fast evolving spectrum hungry user communities that already exist in the more highly developed parts of the world. This creates the perfect scenario for the spawning of new types of communications services and the proliferation of information transit points or "gateways". The teleport concept was developed in response to the problems and opportunities posed by rapid changes in market requirements and regulations. The universal availability of the inexpensive high speed information processors and the installation of new telecommunication links coupled with the global distribution of economy have accelerated the formation of these versatile, multifaceted transmission gateways.

Washington International Teleport (WIT) is the archetypal transmission gateway, provider located on the outskirts of Washington, D.C. WIT is one of the nations oldest and largest teleports. It has become the predominant provider of satellite communications services in the nation's capital relaying via domestic and international satellites some 2,000 hours of video information each week. WIT began its existence as a niche market servicing company providing full service capabilities for the entertainment/media community. During WIT's early days, we provided one service: video access on an "ad-hoc" or a full time basis to the news capital of the world. Over the years, WIT has expanded its niche market geography by adding an extensive metropolitan area network for distribution of information to its customers. WIT owns and operates a comprehensive (approximately 1700 miles) metropolitan area microwave network (12 GHz, 18 GHz and 23 GHz spans) throughout the Washington region providing customers direct access to 24 satellite earth station antennae located at the teleport facilities in the Alexandria, Virginia area. In addition to this extensive metropolitan area network, the WIT transmission gateway site is connected to a national optical fiber network. WIT provides an information traffic hub linking the domestic and regional distribution networks to a national and international transmission network. Thus for various types of customers such as video broadcasters, radio broadcasters, or private network users of data and voice WIT can turn around transmissions to and from various parts of the country to international destinations. This is routinely done not only on a permanent full time contract basis, but also on an "ad-hoc" as needed occasional basis for various customers. While WIT does not function as a local alternative access carrier in the full sense of the term, we have evolved the "wide area network" as a necessary means of controlled connectivity to the major satellite transmission facilities that we own.

When we view the future evolution of Washington International Teleport as a preeminent transmission gateway provider, we have to be cognizant of four major forces influencing the growth of WIT:

1) The location of our serviced market, a major North American capital city with a unique information flow.

2) The diversity and the growth in communication services required by the user community in this area that is realizable by new transmission/distribution technologies, e.g. the types of world crisis related media communication services required by WIT customers and the ability to satisfy them within the constraints of existing spectrum capabilities.

3) Creation of new domestic and international network systems, e.g. the fast evolution of optical fiber networks both in the domestic and the international environments that promise to provide spectacular amounts of capacity for transmission.

4) **The gradual redistribution of global economies and power centers, e.g. the growth of the Asia-Pacific region as a major trading partner and power center.**

While it will be difficult to forecast the exact nature of services and the type of evolution that WIT will go through during the next decade, we can clearly see the influence of these four forces. We strongly believe that these forces will interact to determine the future role of most major transmission gateways formed to aid the growth of the information infrastructure of our society.

The Pacific Region is today inhabited by a population in excess of 2 billion people comprising close to 50% of the world's population. During the last decade the countries of the Pacific region experienced annual growth in GNP close to 10% and a per capita GNP which was more than double the annual world average. This kind of growth is reflected in the telecommunications traffic patterns in the Asia Pacific Region. The telecommunications carriers based in this region as a whole have experienced the highest growth rates in international traffic during the last decade. The growth rates as a rule have been in the 30% to 50% range and intra-region traffic has become as important as international traffic patterns in this area. For example, Australia (OTC) has seen a traffic growth in excess of 30% within the Pacific region as compared to 20% on traffic bound for Europe. The newly industrialized countries (NICs) are becoming more important as traffic builds between them and other major trade centers that they relate to, namely, Japan and Hong Kong. When one looks at the various types of traffic on the space segment facilities it is seen that almost one third (28%) of the equivalent full time voice circuits carried by Intelsat facilities is in the Pacific Ocean region and two-thirds of them are fully digital. In comparison, in the area of private networks approximately 40% of the total Intelsat traffic is in the Pacific Ocean region. These figures show that there are substantial international traffic volumes that are generated by many countries in the Pacific Region and there is significant growth of traffic amongst each other within that region. The rest of the 90's will most likely see an accelerated growth in these traffic figures and a rapid growth of information exchange between Western/Eastern Europe and the Pacific Ocean Region. A hint of this growth can be seen in the estimated volume of 500 million minutes of telecommunications traffic that is expected to come out of Hong Kong and China together in 1990.

While the technological, regulatory and market realities in the international arena dictate the creation of new information gateways, there are a number of basic driving forces that argue for the creation of global gateways in the Pacific communications community.

The coming decade will see a number of changes that will significantly increase the volume of information handled by these new gateways. Chief amongst these changes are:

1) **The Strong Correspondence between Trade Growth Patterns in the Pacific Region and the Telecommunications Traffic Growth and Information Requirements that Reflect the Emerging New Commercial Infrastructure In the Region**

We have seen in the last decade the preeminent information center role played by Japan and Hong Kong which is a direct reflection of the commercial viability of these two areas. As the regional ties evolve and the commercial infrastructure in the Asia-Pacific Region becomes heterogeneous we can see the newly industrialized countries such and South Korea, Taiwan, Thailand, Singapore, etc. becoming major "junction points" for traffic from and to this region.

2) **The Opening up of International Boundaries for New Entertainment Media and for Private Networks**

As the thirst for diversified entertainment programs and up to the minute news coverage of events around the world increases, the need for primary and secondary information gateways also becomes more important. This can been seen in the explosive growth experienced within the television arena in a country such as Indonesia. This country which is an archipelago of over 6,000 islands spanning both the Indian and Pacific oceans has within the last two years created a multiplicity of television entertainment providers bringing in programs ranging all the way from a children's series such as "Sesame Street" to adult entertainment such as "World Cup Soccer" in 1990 and "Miami Vice".

With the accelerating changes in the structure of the world economy more and more corporate structures are becoming multinational operations. The Asia-Pacific Region is particularly attractive to those corporate operations that are labor intensive in nature and want to take advantage of the fast growth rate in the this region. The emergence of major financial centers such as Tokyo, Hong Kong, Singapore and Sidney parallels this economic evolution in this area.

As a result of the establishment of various financial and corporate entities in this region there is a tremendous need to provide customer controlled private network facilities. This again opens up opportunities for national, regional and local information gateway providers.

3) **Alternative Space Segment Availabilities with Easier Access**

As the spectrum requirement for communications increase there have emerged alternate space segment providers (alternative to Intelsat). These providers seem to provide for easier transmission access with less stringent or simplified operational requirements and also look to serve specialized communications requirements in the region such as thin route telephony. Creation of teleports to work with these providers is indeed an opportunity worth exploring.

4) Alternative Transmission Paths

The multiplicity of optical fiber cables such as TPC 3, TPC 4, NPC and Hawaii 5 linking the North American continent to the Pacific region have created large amounts of capacity. This transmission capacity that exceeds 55,000 equivalent voice circuits provides the ability to transmit large amounts of information between the North American continent and the Pacific region. Similarly the creation of intra-regional links such as APC, GPT and HJK have also created alternative transmission means to link the countries within the Pacific region. This capacity is in addition to the space segment capacity available to cover this part of the world. While it does not provide for broadcast modes of transmission the fiber capacity does provide for viable means of point to point digital transmission. Gateways should take advantage of these new modes of connectivity.

5) Enhanced Access Modes in the Region

The increased emphasis on digitalization of the network and increased efforts towards the implementation of the ISDN capabilities in various countries in the region have opened the doors for the introduction of new service capabilities and information access modes in this area. Service capabilities that one takes for granted in some parts of the world such as packet switched networks, leased data networks, CSDN and ISDN are evolving rapidly in the Pacific region countries. A precursor of the adoption of new information access mode is seen in the explosive growth of facsimile traffic both within the Pacific region and between this region and the rest of the world.

THE STRATEGIES FOR THE EVOLUTION OF THE WORLD CLASS TELEPORT

While somewhat limited by the regulatory and political hierarchies prevalent within each country, new teleport activities should try to concentrate on three major areas of implementation and growth to create a successful gateway linking domestic and international networks.
Each area is a logical extension of the current growing market requirements. They are:

Video Network

Existing video transmission business around the world continues to grow for two major reasons. Economic activities, and political conflicts and disasters that span the emotional human dimensions continue to generate more and more television/radio news. News reporters and ever political campaigns are learning to use satellite communications to their advantage. The increasing use of transportable trucks and fly away terminals require a "head end" for receiving and turning around such locational feeds. In addition, the changing dynamics of the entertainment/television industry itself is also creating new business opportunities and demands to provide television stations independent sources of interesting programming material. In countries where there is a growing cable television industry for distribution to the residential viewers the full time cable television service providers require programming material to fill their channels. In the case of WIT, alongside our international earth stations, we also operate 22 domestic antennae (C and Ku Bands) which can provide users with important redistribution ability. For video service (both television and private networks,) this ability to turn around international transmissions to and from other parts of the country is crucial. It is also something few teleports can offer.

Private Networks

The second strategic area for a transmission gateway's growth is in private networks. Such networks are increasingly being used by businesses and institutions for both video and data transmissions. This applies both in the domestic arena (in terms of point to point data transmission requirements, video requirements for training and teleconferences as well as VSAT requirements) and in the international arena. WIT has the capabilities to provide either purely a domestic private network linking many national sites or mixing both domestic and international locations as part of a multi-national network. In addition, in order to provide more than just a broadcast type network, WIT facilities could also be used for the installation of a shared VSAT hub.

This will enable smaller users, those with a few dozen locations, the benefit of VSATs without the expense of installing an in house VSAT hub of their own. By linking the VSAT hub with a national network such as a digital microwave or an optical fiber backbone network it is easy to provide connectivity or a backhaul route to the head quarters location. In addition, the teleport or the gateway location could function as the transit point linking international locations to the domestic locations and the domestic headquarters.

Switched Voice/Data

With a network that combines many transmission technologies, such as the one in the case of WIT, the major national/metropolitan transmission gateway will be able to offer unique international voice/data services. A major teleport's main strategy for international switched voice/data services should be to offer a multi-purpose earth station facility at a much lower cost than available through existing gateways or cable. In addition, it should package services to include the full range of available offering from a provider such as Intelsat, as well as new combinations, e.g. a basic service offering of T-1 or E-1 bulk capacity. The teleport gateway should also be aware of the need for the public network to be ISDN compatible within the next few years and should take into account various factors affecting compatibility of networks for the successful operation of a bridging gateway facility. Once a major gateway has the capability to handle switched voice and data services other types of enhanced communication service offerings could be included.

Such offerings as private and secure communications, designated facsimile access ports, electronic message services and various types of conference capabilities are just a sample of a wide array of enhanced services that could be provided by the gateway facility.

While WIT's foundation was based on being a domestic video transmission provider, our growth into the international transmission arena in the last two years has convinced us that this area presents the most attractive service opportunities for the future. We do believe that the domestic transmission opportunities - be they for broadcast video or for low speed data utilizing spread spectrum techniques - will continue to exist. However, significant growth within the industry will be in the international arena.

We expect that the evolution of the teleports will result in three major categories:

1) Those that serve major country/metropolitans nodes with multiple transmission media access. These teleports will consolidate their anchor transmission roles by adding to their existing capabilities. In addition, we foresee a trend towards vertical integration within this category of teleports in order to accommodate and service their expanding customer base.

2) The second category includes both teleports that serve second tier metropolitan areas and new teleports that are created for a specific purpose, e.g., IBS. These teleports will create a mini teleport hierarchy that is limited in its scope both in terms of services offered and facilities provided.

3) The third category of teleports will be oriented to meeting specific service requirements. These "Specialty Teleports" will be created to address the unique needs of a single specialized user.

In addition new teleport service opportunities in the next decade will be significantly influenced, we believe, by the following factors:

The Evolution of the Teleport's Functionality in the major regions of the world namely North America, Europe and the Pacific regions.

Growth of the Service Sector and the interconnected Information Economy Role of these regions

Creation and acceptance of these new cost effective telecommunication services by major user groups

Growth of the Entertainment/News Media expanding to serve a global customer base

Spread of Telecommunications Deregulation Encouraging Multiplicity of Gateway Providers

and

Evolution of New Technologies and their Acceptance by Various Segments of End Users

Over the last few years, WIT has planned and integrated the major components of a system needed for the successful operation of a gateway facility. Based on this experience we believe the following factors are the key to a successful creation of a major teleport gateway node.

- Define the viable Transmission Focus:

  Depending upon the market realities in the area of operation it is necessary to determine the key requirements for the transmission facility. In the case of WIT it was initially video transmission for the broadcasters that gave it the impetus for the creation of the teleport. It could be a number of other driving business forces that argue for an effective gateway. For instance, a gateway might be needed to provide disaster recovery access, E-Mail/EDI access or even a facility for receiving and transmitting CD quality radio programs.

- Multiplicity of Transmission Technology Capabilities Access:

  An information gateway for it to be a true "gateway", should have access to all the available transmission facilities within its reach. In addition to the space segment access, the ability to interconnect with optical fiber networks, both domestically and internationally, coax cable networks and digital/analog microwave networks is very important. Adding a "MAN" or "WAN" system provides for better service and control of the customer base.

- Have Multiple Space Segment Access:

  Access to domestic space segment as well as all available international space segment providers with the ability to interconnect them make the teleport facility attractive to different segments of users.

- Access Alternate Local Distribution System:

  A fully negotiated and tariffed access to an existing local operating company for delivery and pick-up of customer traffic is essential. This provides an alternative to the teleport owned wide area network system. In addition, interconnections and other working arrangements with major domestic and international common carrier networks are desirable in order to serve those customers who have to either come through or deliver to these types of networks.

- Install Switching:

  Switching capability a two tiered for the traffic by the teleport is one capability that would significantly enhance the status of the teleport service.
  The two tiers represent both the switching capability at the physical teleport location in order to dedicate different types of facilities for the customer as well as the switching capability that is embedded in the wide area network that forms the distribution system. This two level switching capability allows the teleport service provider to offer redundancy and also to be able to interconnect other domestic and international common carrier network facilities in case of transmission difficulties.

- Consider Full Time Staffing

  The ability to fully staff and operate around the clock with human resources to provide the necessary operations, traffic, and technical maintenance services for the customers is an essential element of the operation of a major teleport. The traffic department is particularly important if the gateway is in the business of providing occasional transmission services in addition to full time services. These occasional services, especially on an international basis, require significant amounts of back and forth coordination and arrangement that only a well trained 24 hour traffic department can handle. In a smaller gateway operation it is also important to cross train the staff personnel in order that one group of people can cover for the other in terms of significant increase in demand for the services of the teleport. Hence, it would be necessary to rotate the staff personnel within the various disciplines to familiarize them with all the duties of the teleport.

- Plan for Expansion:

  An inherent capability for future growth in terms of new facilities should also be considered in the planning. These capabilities translate into environmental controls that are in place to make it fully compliant with various rules and regulations in existence, interference protection for access and transmission of signals, a full frequency clearance for operations, minimal radiation hazard in the near by area and the ability to add additional transmission antennae.

- "Design-in" alternate Power Source:

  Ability to operate independently of the power supply authorities serving the teleport area is an absolute essential.

  In order that the transmission and reception activities go on uninterrupted, a fully functional uninterruptable power supply backed by stand-by generators that come on line in case of long power interruptions or voltage fluctuations must be planned and implemented prior to the start up of the teleport facility.

- Create Responsive Administration:

  Additional administrative items such as (i) proper focused marketing/sales activities in order to create a good anchor customer base for the teleport and (ii) timely recording and billing of the services rendered in order to collect the funds due in a timely manner as well as resolve any disputes are also obviously necessary for the successful operation of the teleport business.

I have only mentioned some of the key elements that have made the operation of WIT a success in North America. We often hear different predictions and arguments regarding either the explosive growth of teleports dotting the country side to become multi-faceted transmission entities or a slow demise of teleport due to proliferation of different types of transmission capabilities around the world. It is ironic that while this uncertain future of the teleport entity in North America is being hotly debated the concept of a concentrated transmission hub or a teleport is becoming a very attractive technological opportunity in other parts of the world. We believe that neither extreme prediction is entirely correct. In our opinion, new service opportunities for WIT will fall into two major categories:

Translation of the key terrestrial services that have become a success in North America into the international arena and;

Specific transmission requirements that are uniquely space segment dependent due to either country connectivity or economic reasons.

The international role of a teleport gateway will certainly be stimulated by the increased sophistication of the telecommunication services offered to users. Teleports can be expected to play pivotal roles in providing many of these services. The decade in front of us can be expected to create major transmission roles for teleports in the following areas:

1. Restoration Services: Ability to provide a "stand by" restoration capability for alternate transmission paths such as fiber optic links is a necessity.
   This role can effectively be serviced by a major international gateway with the cooperation of space segment providers and users.

2. Disaster Recovery Access: A diversified distribution network in a metropolitan area combined with direct access through teleport facilities to a commercial hot site, a shell site or to a service bureau, can provide excellent disaster recovery to a financial or commercial enterprise.

3. Bulk Data Transport: It is not uncommon to find companies that transport bulk data in the range of 30 to 50 Gigabytes every night between a large mainframe and a mini host. Obviously, a 64k bit SDLC line is totally inadequate, but a data pipe from the teleport is ideally suited to facilitate this transfer.

4. Data Base Access: Teleport can provide direct access to large reference data bases co-located in the serving area of the teleport. The location of valuable, large and critical data bases in an environment that promotes easy diverse media access would be significantly attractive to data base providers.

5. E-Mail/EDI Gateways: The creation of new "enterprise inter-networks" that extend the reach of commercial enterprises requires the universal implementation of X·400 and X·500 guidelines.

Teleports can provide multi-user access to the E-Mail gateways co-located at the teleports linking workstations on LANs and WANs.

6. Cellular and Paging Services: Together with mobile (MSS and RDSS) services, the roles of cellular telephony and paging services are going to be significant in the coming decade and global economy. A teleport facility would not only provide the domestic traffic concentration point for these services, but also the international transit center.

7. Meganet Mediation: Communications managers of over-burdened data networks are eagerly awaiting the implementations of Fiber Distributed Data Interface (FDDI), SONET, cell relay fast packet switching and BISDN. Teleport gateways have a significant role to play in providing the national and international connectivity to these new networks.

8. IMTS Transfer: Teleports can provide the bridging point to terminate and re-originate IMTS traffic and can provide links to bridge the fiber and satellite routes.

These are just a few of the potential growth opportunities for the coming decade. Although there will be significant changes in regulation, in technology, and in the values and desires of our customer base, we at WIT believe that there will always be a viable role for teleports in major information-intensive metropolitan areas of the world.

The Global Virtual Private Network

Peter Branson, General Manager Operations
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and
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Hong Kong Telecom International

In conjunction with US Sprint of the USA and Mercury Communications of the UK, Hong Kong Telecom have recently introduced a "Global Virtual Private Network Service". This paper describes the product itself, its relationship with the evolution of ISDN in Hong Kong, and the market forces which stimulated its introduction.

Exploitation of new technology in Hong Kong

The pace of technological development in the telecommunications industry has been slow for most of its existence. For decades, submarine telegraph cables and, later, HF radio, were the backbone of the telecommunications business. As a result, text-based messaging was limited both in available character set and speed of transmission, and international telephony was generally poor quality and involved long call set-up times. It is really only in the recent past that innovations such as satellites, coaxial cables, optical fibre systems, digital transmission and switching, have brought IDD, packet switching, high data rates and wide bandwidth availability within the customer's reach. Other recent developments, such as the personal computer, facsimile machine, and intelligent office equipment (CBXs etc), have combined to provide an astonishing variety of facilities at the customers' fingertips.

The spread of office automation - the PC, the fax machine, intelligent PBXs, communicating word-processors - goes on and on. The spread of information technology has been dramatic; who could have predicted as recently as ten years ago that so much computing power could be made available on a desk, or that so many desks would have a PC on them. It is perhaps worth reminding ourselves that the late Thomas Watson, CEO of IBM, speaking in the 1940s, could only envisage a world-wide requirement for less than 100 computers! The power of the computer, when linked with communications, opens up a multitude of opportunies. Remote database use, once a specialist preserve, is now within the reach of most executives. Electronic mail, transfer of spreadsheets, databases, graphics, reports - again the list of applications is almost endless. Our Customers today, especially multinational corporations, both understand and expect to use evermore sophisticated services.

The problem with all this is that telecommunications industry gets totally seduced and enthralled by the possibilities of new technology, forgetting that for most of our customers, they really couldn't care less. They don't want to know about what goes on inside our equipment; how many transistors we can get on a chip, or how many circuits can be squeezed into one optical fibre; they want to know what they can do with it.

All too often, our industry falls into the trap of believing that technology is all but, in the Hongkong Telecom Group, we recognise that we have to consciously seek to understand what the market wants, and provide that to them, rather than just give them what somebody else thinks is good for them. For that reason, we have introduced the Global Virtual Private Network. Some of you may say: "But why? the ISDN is just around the corner, why not wait until that is available on a global basis? It will do most of what GVPN offers." The simple answers are: because it doesn't do everything that our customers want, and it isn't here today when they want it.

ISDN, when it is implemented and available on a truly world-wide scale, will offer many innovative and effective communications options and alternatives for international businesses. But we have recognised that although international ISDN is developing quite quickly, business requirements have developed faster, outstripping the services available to meet them. We have also recognised that multinational businesses, indeed all businesses, want choice; services which might be facilitated on the ISDN could be attractive, but may need to be packaged in alternative ways so as to provide that choice.

Hongkong's status as the premier international business centre in South East Asia has owed much to its advanced communications, both physical and electronic. Its geographic location has long attracted major multinational corporations wishing to take advantage of both a gateway to China, and its strategic position at the crossroads of Asian business. We believe that Hongkong is unique but for unique problems, unique solutions must be found. The business community in Hongkong, just as in any other major business centre, requires services and facilities attuned to its own needs, not the needs identified by somebody else, thousands of miles away.

Multinational businesses also recognise that they operate in different environments; this can leave them somewhat schizophrenic when it comes to choices in telecommunications facilities that they use. A private leased circuit network may be just what they need in one location, but in other locations, switched services are the answer. Until today, the sort of flexibility that they need has not been available to them on an international basis; as a result they have had to make do with a compromise.

The Global Virtual Private Network

With this in mind, Hongkong Telecom International, in association with US Sprint and Mercury Communications, has embarked on the Global Virtual Private Network (GVPN) programme. GVPN combines the functionality of a traditional private network with a range of advanced ISDN-type facilities, extending the options for businesses. It provides dedicated connectivity within a switched network, enabling a closed-user group to have a private network on a shared-resource basis, thus offering a very cost effective alternative to a fully dedicated private network. The switches used on the GVPN offer many of the advanced features that ISDN will offer - abbreviated dialling, call forwarding, caller identification and full 64 kbps data transmission are just a few features our customers on the GVPN can use.

Initially, the GVPN links together users throughout the USA and UK to Hongkong, but plans are in hand to all other locations to the network. Canada is already committed to joining us in this venture and we expect to increase the number of GVPN "outlets" in Asia, the Pacific Rim and Europe as demand for the service grows. A service like GVPN will, of course, require a critical mass to be successful. That in turn demands a truly global presence. Hongkong Telecom and our associated companies within the Cable and Wireless Group are ideally positioned to lead this venture, with operations in over 40 countries on five continents, but we warmly welcome other participants who want to join us in the forefront of meeting customer requirements.

In some cases, extension of GVPN will be made by interconnecting with national ISDN facilities, whilst in others it may remain as a separate, alternative service. Technically, there is no reason why what we view today as an interim step on the road to full ISDN service should not be in future an integral part of the ISDN. However, the final decision will be left to the users -it is after all, them that we are serving, and it is only right that they should be involved in determining the way services are developed and offered - otherwise ISDN really will be "Innovations Subscribers Don't Need".

Our commitment to GVPN as a means of delivering services to multinational customers does not mean that we are concentrating all our efforts there and ignoring ISDN. Far from it - we are fully committed to the introduction of ISDN, and the Hongkong Telecom Group, as part of our continuing investment programme, is introducing ISDN technology throughout its network. CCITT No. 7 signalling is already in use both nationally and internationally, and has played a fundamental role in our development plans.

The Hong Kong domestic telephone network is already 75% digital and will be completely digital by 1993. There is a digital presence in every one of our 70 exchanges and all are interconnected with C7 trunks. Six of our major international links are already operating C7 and the others are to be converted as soon as our correspondents are ready.

However, international C7 is currently limited to the CCITT "Red Book" TUP specification whilst some of our customers need service features which demand a more advanced form of signalling. As C7 ISUP will not be generally available until 1991/1992, we decided that it was necessary to meet our customers immediate needs by providing a "seamless" international overlay network based on an advanced proprietry signalling system.

The technology

Another speaker at this conference will be addressing you on the technology we are using to provide the GVPN. In light of earlier remarks about our fatal fascination for technology, it would be inappropriate to dwell on it here, other than to say that, important though the technical features of the equipment may be, to us a more important factor is the service features available. The decision for us was not "What services can we offer on this platform?" but 'What platform do we need to offer these services?".

The result of our deliberations was that we chose the Northern Telecom DMS range of switches. With them, we are able to offer, today, the services and features that users require. We hope to work towards a situation where the innovations available through our Northern Telecom equipment will be widely available as standard on a variety of manufacturers' switches, enabling more administrations to join us in global networking.

The switches support a number of different interfaces; in Hongkong we connect at V.35, Primary Rate Interface and Basic Rate Interface specifications, as well as 2 or 4 wire telephone lines. Our partners will be supporting the range of connections which suit their own specific market requirements. The international network is based on 64 kbps digital circuits, routed over fibre-optic cables wherever possible. Our commitment is to deliver high quality services, and to expand and enhance them in line with the needs of the users.

The Service - what is it, and why provide it?

GVPN addresses a fundamental business need: it gives the customer the ability to manage his own organisation's voice and data traffic, which might normally go over the public network. It also combines some of the facilities that would normally be achievable only by having a dedicated leased circuit network. For many companies, that represents a significant investment, not just in money, but also in terms of management time and staffing resources. That investment may be one that is hard to justify - now with GVPN, there is an alternative, an intermediate between solely using the public switched network, or building and running a dedicated private system.

In designing and building the GVPN, our customers' requirements have remained uppermost in our minds. We believe that the fundamental building blocks to meet their needs must offer them:

speed - fast call set-up, with calls connected instantaneously across the world;

flexibility - bandwidth can be increased as and when required, handling the peaks and troughs of international telecommunications;

convenience - facilities managed on customers' behalf, leaving them to concentrate on their core business;

simplicity - a global numbering plan, with a unique customer-defined six, or seven, digit structure, which enables easy worldwide access.

The range of enhanced facilities from which a GVPN customer can selectively choose is too wide to cover in a presentation of this duration, so we have concentrated on a limited number of the most significant features.

Closed User Group:

> The Closed User Group facility on the GVPN allows for interconnection between two customers who may have a business relationship requiring heavy communications between areas or departments within their companies.
>
> It allows the features of GVPN to be shared between two separate GVPN customers. The calls, voice, data or video, are initiated on one customer's Global Virtual Private Network and carried onto a second without any loss of capability, capacity or features.

Seven Digit Dialling:

> A customer defined numbering scheme which offers office to office calling using only 7 digits.

Hotline:

> Immediate connection to a predetermined number. No dialling required.

Call-by-call Selection:

> Also known as Integrated Services Access, or ISA, this allows the user to replace several dedicated lines (for example, one for voice, one for data and one for video) with a single point of access onto the network.
>
> The terminal user retains the same access number regardless of whether the call is voice, data, or video, yet identification of the type of call allows for dynamic network

configuration (switching in or out of echo cancellers, for example), ensuring the highest quality service for specific applications.

Switched Clear Channel Data:

A switched clear channel at either 56 or 64 kilobits per second, it allows end-to-end transparent data transport. GVPN switched data offers a faster service than can be achieved using the PSTN. The switched data channel offers a cost effective alternative to a dedicated line, and allows the user access to as much line capacity as is needed, up to 64 kbps. Multiple channels can be switched to the same destination for higher bit rates.

The switched data channel, combined with call-by-call selection, will allow customers to maximise use of the latest customer premises equipment, including single voice and data terminals, video phones, and Group 4 fax.

Calling Line Identification:

Displays the number of the caller on the recipient's terminal. The user can screen calls, identifying the name of the caller. Integration with their own automatic database look-up facility provides our customers a powerful business tool.

Network Name Delivery:

When a GVPN user receives a call the caller's name will be automatically displayed on the receiving equipment. An enhancement of the Calling-line Identification feature, Network Name Delivery allows the recipient of the call to screen it before answering.

Network Ring-again/Ring-back When Free:

If a user calls a busy line, this feature will notify him when the line is free again and re-make the call. This is a widely used PABX feature. With GVPN it is available network-wide between any "on-network" locations around the world. It saves time spent having to re-make calls, minimising the frus tration of "telephone tag".

Call Forward:

If a user is absent from his/her office, calls can be forwarded to another number so that the call is answered. Until the introduction of GVPN, this feature has not been available on country-to-country calls. We expect users to find additional applications for this feature, such as global 24-hour help lines, enquiry desks, and messaging services.

Already, this feature, together with the Network Name Delivery feature, is being seen as the start of the development of the "global personal telephone number".

Despite GVPN having only recently being made available, major multinational corporations are already recongising the attractiveness of this feature-rich offering. They can readily see the benefits to themselves:

GVPN eliminates the multiple vendor and carrier problems associated with international private networking.

GVPN facilitates global cost management, with a three-layered call identification code system. For billing purposes, an authorisation code isolates all company calls, an account code isolates all department calls, and a personal identification number attributes calls to an individual. GVPN provides global 24-hour network management for customers and regular management reports on network usage and traffic levels.

GVPN can interface with and act as an extension to most private networks, mirroring its dialling plans and functions for voice, data and video. In addition, its flexibility and efficiency is passed on to the user in the form of lower per-minute charges for calls.

By integrating GVPN with an existing private network, users can effectively upgrade their private network to offer advanced GVPN-based features.

And, of course, by no means least, GVPN is offered over the Global Digital Highway, which uses the latest fibre optic technology nationally, regionally and intercontinentally, to deliver the highest quality telecommunications it has yet been possible to provide.

The future

Companies who understand what "competitive edge" means, realise that simple acts, such as dialling a telephone number, writing a telex, or sending gigabytes of data internationally, all take time. Saving time means greater productivity, and hence profitability. The question they ask is not so much "Is it cheaper to do it this way?", but rather "Is it better to do it this way", together with "What can I do with this that I couldn't do before?" In short, companies competing in the global economy understand that they can derive significant benefits from innovative use of technology; indeed, not only do they recognise this fact, they understand they have to actively seek solutions, perhaps even before they have the problem.

GVPN is available today to all of our multinational customers. Some of them may be able to achieve a higher level of flexibility with PABX equipment which support interfaces compatible with those used on the GVPN switches; currently, these include the SL1 and SL100 systems, and DPNSS, although not all are supported at every location at the moment. However, we are actively pursuing the expansion of the range of interfaces which are supported, so that more users can obtain the greater flexibility and advantages offered by full interworking.

We believe that GVPN offers today those innovative solutions that our multinational customers want. It is an alternative to a dedicated private network, with the flexibility of public switched services. As time progresses, many features will be available internationally over the ISDN. Our policy will be to continue to offer a choice to our customers, and to continue the development of the GVPN, in parallel with ISDN and other services in order to provide the underlying communications infrastructure so vital to global economic activity.

Interface Between the Gateway Switch and Digital Circuit Multiplication Equipment

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1. ABSTRACT

Digital Circuit Multiplication Equipment (DCME) is a concentrator which can accept several 2-Mbit/s links carrying either voice, voiceband data, or 64-Kbit/s digital data and transmit them over a single 2-Mbit/s digital link. By providing the interface between the gateway switch and DCME, the existing international traffic capacity of a PTT can be dramatically increased without deploying new and expensive international facilities. AT&T's 5ESS® gateway switch can support two interfaces to the DCME. The first is a hardware interface that provides dynamic load control. The second is a sophisticated software interface that provides per call control, traffic control, and maintenance information. With this sophisticated DCME interface, all types of calls, even ISDN calls, can be supported.

In this paper, a description of how AT&T's 5ESS gateway switch interfaces with DCME is presented. Included are an overview of DCME, a description of the interface protocol, and a discussion of call processing.

2. DCME OVERVIEW

Digital Circuit Multiplication Equipment (DCME) is a transmission equipment used in International Switching Centers (ISCs) to provide a transmission facility concentration function. It can accept up to eight 2-Mbit/s links from a gateway switch and transmit the received traffic over a single 2-Mbit/s digital link.

The types of calls that DCME can support are:

1. voice call (telephone call),
2. 64-Kbit/s data call, and
3. 3.1 KHz voice-band data call.

DCME employs several signal processing algorithms to support these different types of calls. Therefore, to provide the proper call processing algorithm for each outgoing international call, the gateway switch and DCME must invoke a hand-shaking procedure during the call setup sequence; this is the per call control capability.

In addition, because of DCME's concentration function, there is a need to convey the traffic information (e.g., DCME overload) between the gateway switch and DCME.

The signals conveyed between the gateway switch and DCME are classified into the following two categories:

A. Traffic Control Signals (TC) - The TC signals are the signals related to the status of the DCME (e.g., DCME overload).

B. Service Select and Availability Signals (SSA) - The SSA signals are the signals related to the status of an individual circuit and are sent on an individual circuit basis. The Service Select signals are sent to identify the type of call attempt, and the Availability signals are sent to indicate the circuit status.

3. DCME HARDWARE INTERFACE

The hardware interface to the DCME is set up to provide minimal communication between the 5ESS gateway switch and the DCME equipment. The communication "link" is a single wire pair running from the DCME to a scanning unit on the switch. This allows Dynamic Load Control (DLC) of the call traffic on a particular DCME.

When the DCME is processing heavy call traffic, it will occasionally overload and be unable to process new traffic without significant degradation of existing traffic. Once this overload is reached, it is signaled to the 5ESS switch by relay contact closure. This closure is detected by the 5ESS, and timing is begun to ensure no rapid oscillation of the relay is occurring. Once timing is complete, the 5ESS prohibits new outgoing traffic on engineering routes associated with the overloaded DCME. As the existing traffic subsides, the DCME opens the relay contact, timing is done, and finally new outgoing traffic is allowed again.

With this dynamic load control mechanism in place, good quality communications can be maintained.

4. DCME SOFTWARE INTERFACE

4.1 PROTOCOL

AT&T's 5ESS gateway switch adopts the following protocol for the DCME software interface which is in accordance with the CCITT Blue Book Q.50 Annex A recommendations. These DCME signals are carried within TS16 of the 2-Mbit/s link by using the standard Frame and multi-frame structure for channel associated signaling as stated in G.704 of the CCITT Red Book.

A. Traffic Control Signals (TC) - The traffic control signals are carried by bits 7 and 8 of TS16, frame 0.

- DCME-to-ISC
  - a. Dynamic Load Control (DLC)
  - b. No 64-Kb/s Capacity
  - c. Maintenance Release Request
  - d. DCME Normal
- ISC-to-DCME
  - e. Maintenance Release Request Acknowledgement
  - f. DCME Circuits Idle
  - g. ISC Normal
  - h. DLC/No 64-Kb/s Acknowledgement

Note that both "DLC Acknowledgement" and "No 64-Kbit/s Capacity Acknowledgement" use the same Traffic Control signal pattern.

In addition, bit 5 (which is also a spare bit) of TS16, frame 0 is set to 1 to ensure that the multi-frame alignment signal is not simulated.

B. Service Select and Availability Signals (SSA) - These signals are carried by the A and B signaling bits of TS16, frames 1 to 15. To ensure that the channel associated signaling does not simulate the multi-frame alignment signal, combination 00 cannot be used. Hence, the signals carried by TS16 frames 1 to 15 are as follows:

- ISC-to-DCME
  - i. 64-Kb/s Request
  - j. 3.1 KHz Request
  - k. Normal Service Available
- DCME-to-ISC
  - l. Special Service Acknowledgement
  - m. Channel Out-of-Service or Unavailable
  - n. Normal Service Available

4.2 PROCESSING OF TRAFFIC CONTROL SIGNALS

The 5ESS gateway switch receives the following TC signals from DCME and performs actions as necessary:

A. Dynamic Load Control (DLC) - This signal means a particular DCME that sends out this DLC signal is in overload condition.

The 5ESS gateway switch performs the following actions:

1. Identify the DLC signal.
2. Send the TC "DLC Acknowledgement" signal to DCME, if the acknowledgement for receipt of DLC has been provisioned.
3. Prevent new calls being set up for this DCME. This DLC blocking situation lasts until a TC transition is received by the 5ESS gateway switch.

B. No 64-Kb/s Capacity - This signal means a particular DCME that sends out this "No 64-Kb/s Capacity" signal cannot accept anymore 64-Kb/s calls.

Actions that the 5ESS gateway switch performs are the same as DLC actions described above.

C. Maintenance Release Request - This signal is sent from DCME to ISC when a DCME terminal is to be deloaded for maintenance.

The 5ESS gateway switch performs the following actions:

1. Identify the "Maintenance Release Request" signal.
2. Send TC "Maintenance Release Request Acknowledgement" signal back to DCME.
3. Block new calls to this DCME.
4. Send TC "All DCME Circuit Idle" signal back to DCME when all circuits are idle. This maintenance release situation lasts until a TC transition is received by the 5ESS gateway switch.

The ISC can refuse the "Maintenance Release Request" by withholding its "Maintenance Release Request Acknowledgement" signal (step 2 in the above actions).

D. DCME Normal - This TC signal is sent from DCME to the gateway switch when DCME is in the normal working situation (i.e., not in "DLC", "No 64-Kbit/s", or "Maintenance Release" situation). Upon receipt of this signal, either no actions are required for the gateway switch to perform or the abnormal situation (i.e., "DLC", "No 64-Kbit/s", or "Maintenance Release") is terminated.

4.3 PROCESSING OF SERVICE SELECT AND AVAILABILITY SIGNALS

When a gateway switch needs to set up an outgoing international 64-Kbit/s data call or 3.1 KHz voice-band data call through a DCME circuit, it has to send out the service request to DCME and get its agreement before the call setup can be completed. The 5ESS gateway switch uses the "sequential" call processing scenario to perform the handshaking procedures.

A. 64-Kbit/s Request - When the gateway switch sends out this signal, it requests DCME to set up a transparent 64-Kbit/s channel without applying Adaptive Differential Pulse Code Modulation (ADPCM) or Digital Speech Interpolation (DSI) processes.

Upon receiving and identifying a 64-Kbit/s call request from the national network and attempting to use an outgoing circuit that terminates at a DCME, the 5ESS gateway switch performs the following actions:

1. Send out the "64-Kbit/s Request" to DCME on the desired channel and enter into the "Await for Acknowledge" state (starting a 1-second timer). Because the "sequential" scenario is used, the 5ESS gateway switch waits for the "Special Service Acknowledgement" signal from DCME before taking any further call setup procedures.

2. If the 5ESS gateway switch receives the acknowledgement signal from DCME on the desired channel before the timer is expired, then it pursues the normal call setup procedures.

3. If the 5ESS switch does not receive the "Special Service Acknowledgement" signal from DCME on that channel before the 1-second timer has expired, then this call attempt is failed and a "re-hunt" is initiated.

B. 3.1 KHz Request - When the gateway switch sends out this signal, it requests DCME to allocate a channel which is optimized for the transmission of data at a speed of up to 9.6 Kbit/s.

The call setup procedures that the 5ESS gateway switch performs are the same as the 64-Kbit/s procedures described above.

5. CONCLUSION

The gateway switch and DCME working together can dramatically increase the existing network capacity without deploying new facilities. For the already crowded international network, this implementation cannot only save significant initial costs for deployment of new facilities, but also can provide capacity for voice and data services to meet the growing demand very quickly.

In addition to the DCME hardware interface, AT&T's 5ESS gateway switch also supports a sophisticated DCME software interface which can provide per call control, traffic control, and maintenance information.

6. REFERENCES

CCITT Q.50 Recommendations

Cable and Wireless PLC: A Portrait of Global System-Building

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This paper analyzes the unique approach to global network development taken by Cable and Wireless plc, with particular emphasis upon its operations in Hong Kong, Japan and Macau. The most interesting aspect of Cable and Wireless's strategy is its integration of local networks with long distance/international networks. Whereas the worldwide trend is to separate local from long distance telecommunications, as in the U.S. and Japan, in some cases by the radical tactic of divestiture, Cable and Wireless has acquired ownership interest in local telephone networks in Hong Kong, Macau, and the Caribbean, integrating them financially and operationally with the international system. The advantages and disadvantages of this approach to network development and its implications for competition will be explored.

This is the age of disintegration in telecommunications. Open Network Architecture, equal access for long distance carriers, global standardization, co-location of facilities, local exchange bypass--all are intended to unbundle services and facilities to pave the way for a "pluralist network." The goal of disintegration is greater economic rationality. Economists (and increasingly, public policymakers) see it as the way to a competitive telecommunications system purged of cross subsidies and open to diversity and specialization. Sometimes this is achieved gradually, through relaxation of regulations and barriers to entry. In the U.S., of course, the goal was pursued more radically, by forcibly breaking up the vertically integrated Bell System.

This is a case study of an international telecommunications firm whose development strategy runs counter to this trend. In a time of network modularization it has chosen to position itself as an end-to-end supplier. In an age of competition and privatization, it has entered into ownership partnerships with numerous governments and obtained long-term licenses giving it monopoly control of domestic and international markets. In the midst of a trend toward technical and economic segregation of local and long distance networks, it has integrated the ownership and operation of international and local exchange telecommunications. That company is Cable and Wireless plc, a British firm which likes to refer to itself as "The World Telephone Company."

The case of Cable and Wireless has interesting implications for the study of telecommunications policy and economics. In the social as well as the physical sciences, it is often the case that anomalies--phenomena which appear to contradict the predictions of the accepted theory--are the most instructive cases. If indeed disintegration has become the norm in telecommunications in most developed countries (and a number of theories have been posited to explain why this is happening[1]) what are we to make of Cable and Wireless? Why has it chosen an alternative path? What are the effects? How do its actions square with the economic orthodoxy regarding the virtues of a less integrated, more competitive market structure? What are the implications for policymakers?

1. Cable & Wireless: A Basic Profile.

Ranked by minutes of traffic, Cable and Wireless plc (C&W) is the world's tenth largest carrier. C&W and its associated companies conduct business in 48 countries and employ over 37,000 people. In 23 of those countries, it controls both the domestic and the international public switched network. In 13 countries, it supplies only international telecommunications. Its major holding is the Hong Kong Telecommunications Group, which in 1989 accounted for 58% of its revenues and 75% of its profits. Mercury Communications Ltd., the second network of the U.K., is 100% owned by C&W. C&W also owns: majority shares of the domestic and international network of Macau; numerous domestic and international facilities in the eastern Caribbean; 16% of International Digital Communications (IDC), one of the two new international carriers in Japan; shares in transatlantic, transpacific, and Asian submarine fiber cables.

Historically, C&W was the telecommunications carrier of the British empire. A private company, it received exclusive concessions to connect British colonies with the motherland, first by undersea telegraph cables and later by telephone.[2]

The company reached the pinnacle of its success in the years preceding and following World War I, but its hegemonic power declined along with the British empire. The company was nationalized after World War II.

With the rise to power of the Thatcher administration, the British government began to view privatization and liberalization as tools to make its telecommunications firms more modern and competitive. In 1980, Sir Eric Sharp was recruited from Monsanto to be Chief Executive of C&W. A year later, 50% minus one share of the company's stock was sold to the public.[3] The British government intends to hold on to majority ownership of C&W for the foreseeable future.

The privatization of C&W was responsible for creating the current framework of international telecommunications in Hong Kong. At the time of the privatization, C&W split off its Hong Kong operations into a subsidiary incorporated in the colony: Cable and Wireless Hong Kong (CWHK).[4] C&W agreed to sell 20% of the new subsidiary's ordinary share capital to the Hong Kong government's Financial Secretary for HK$ 763 million. The government was also given the right to appoint two directors to the Board of CWHK. In return for allowing the government its holding, CWHK received a 25 year exclusive license to provide all external telecommunications for the colony. This government partnership/ exclusive license arrangement became the model for C&W operations elsewhere (See section 4).

2. Building the Global Digital Highway.

Under Eric Sharp's leadership, and with Hong Kong as its flagship operation,[5] C&W set out to construct a "Global Digital Highway." This meant that C&W would become an end to end supplier of international telecommunications. The most advanced digital and fiber optic technologies would be used to connect the primary economic and financial centers of the world and link together its holdings in various countries.

C&W is unique in this regard. Most telecommunications service providers are still basically national entities. While they may carry international traffic, it is generally into and out of their home country. When such firms have overseas investments, their operations are usually in newer, ancillary services such as paging or mobile telephone service, and their acquisitions are essentially unconnected responses to local opportunities. C&W, in contrast, owns or controls the basic public network in most of the countries in which it operates, and strives to connect these facilities together into an integrated system.

The global system-building is evident from C&W's aggressive investments in submarine cables. With US Sprint, the 3rd largest long distance carrier in the U.S., C&W is co-owner of the private transatlantic fiber optic cable PTAT-1. PTAT-1 connects C&W's Mercury system in the UK with its operations in the U.S. A spur that runs south from PTAT-1 links C&W's many Caribbean telephone companies directly to the digital highway. On the Pacific side, C&W is co-owner of the North Pacific Cable (NPC) running between Japan and the northwest coast of the U.S. NPC will become operational at the end of 1990. Two other fiber optic cable projects in which C&W is involved will complete the links between the Asia-Pacific region and the U.S. and Europe. The so-called H-J-K cable connects Hong Kong with Japan and Korea.[6] The Asia Pacific Submarine Cable System (ASPAC) will connect Tokyo, Hong Kong, Singapore, and possibly Shanghai.[7] The new international cables will give Asian countries such as Hong Kong and Singapore direct fiber optic links to the U.S. and Canada for the first time. More importantly, they will complete the link between C&W's operating companies in Hong Kong, Macau, and Japan with its systems in the U.S., the Caribbean, and the U.K.

3. The Strategy of Integration.

In creating its global highway, C&W has adopted a unique strategy with respect to the relationship between local and international services. In most of the developed, liberalizing countries the trend is toward unbundling of the public network. In particular, there has been a tendency to separate local access and long distance services. In the U.S., local and long distance providers were broken apart by the divestiture. A similar division is evolving in Japan, where the New Common Carriers are long distance companies who rely on NTT for local distribution. In direct opposition to this trend, C&W has repeatedly moved to integrate ownership and operation of local and international telephone companies wherever it has a presence.

The most dramatic example of this policy was the creation of Hong Kong Telecommunications Ltd. in 1988. Until the mid-1980s, CWHK and the local Hong Kong Telephone Company (HK Tel) were separate entities. HK Tel was a locally owned, regulated utility. Between 1983 and 1984, C&W quietly acquired a majority of its stock, then merged it with Cable and Wireless (Hong Kong) in 1987 to form Hong Kong Telecommunications Ltd. (HKT). In 1988, as part of the merger arrangement, shares in HKT were sold to the public. Today, Hong Kong Telecommunications is a holding company with two major owners: Cable and Wireless plc (58.5%) and China's state-owned foreign investment company CITIC (20%). The remaining shares are held by the general public. HKT in turn owns 100% of both the local and the international telecommunications providers.

HKT is by far the largest integrated company, but C&W holdings throughout the world conform to the same pattern. In Macau, the C&W-owned Companhia de Telecommunicacoes de Macau S.A.R.L. holds the exclusive license for all domestic and international telecommunications services. C&W owns 51% of its shares; the Chinese government and two other Portugese companies hold the remainder. In the latter half of the 1980s, C&W integrated ownership of the international and local networks in several Caribbean nations. Telecommunications of Jamaica (TOJ), Grenada Telecommunications Ltd. (Grentel), Skantel in the islands of St. Kitts and Nevis, to name just three, followed the same pattern.

Integration of local and international service is a response to political, technical, and economic factors. Technologically, in the words of one C&W spokesman, "the incursion of digital technology into an analogue world added a layer of complexity to the interconnection process; additionally the potential to combine local, toll, and gateway hardware and software into one unique switch was becoming a reality."[8] Integration of local and international services thus allowed internal administrative coordination to achieve technical compatibility. Given the complexities of dealing with multiple independently-controlled PTTs subject to political regulation, direct ownership simplified the coordination problems.

Economically, integration also gives C&W more control of the allocation of revenues and costs. The HKT merger came after several years of disputes between C&W, the Hong Kong government, and the local telephone company about the revenue sharing arrangements between local and international service. Shortly after the merger, C&W implemented a new formula for allocating international revenue between the local and international telephone companies. One can speculate, therefore, that the revenue settlements issue was one motive behind the merger.

Additional support for this interpretation comes from Mr. Ray Smith, the Chairman of Grentel. In his Report on Telecommunications Licensing in Grenada, Smith expressed the philosophy underlying the integration of local and international telecommunications in small, developing countries. Smith noted that Grenada's telecommunication system had been plagued by a recurring problem for the past fifty years: an inability to generate sufficient funds needed to continually modernize and expand the network. Grenada had experimented with various ownership schemes (government, private contractors) and each worked adequately as long as the initial investment and technology lasted. Each arrangement faltered, however, once it was faced with the need for heavy capital investment to expand or modernize. The Smith Report concluded that the solution to the problem was common ownership of the international and domestic network:

> (common ownership) creates a financial linkage between the surplus-generating external system and the capital-hungry internal system which needs repeated infusions of capital for replacement, growth and expansion.[9]

Of course, the ability of the external system to generate a surplus is dependent upon its being part of a protected monopoly with end-to-end control of the system. A monopoly can extract high profits from business users whose operations are dependent on international communications. Such users, whose core demand tends to be inelastic, will be forced to pay higher rates as long as there is no competitive alternative. The ability to "tax" international usage to finance domestic network development explains the willingness of many governments to grant exclusive licenses.

4. Hubs, Spokes, and Competition.

Each of the integrated telecommunications entities is a partnership between C&W and the host governments. Typically, C&W holds the majority of the shares. The participation of the government makes it possible for the integrated firms to obtain long term licenses giving them exclusive rights to carry domestic and international traffic. These licenses are typically of 20 or 25 years in length.

C&W's policy toward competition and liberalization may seem contradictory but is actually very shrewd. In the world's telecommunications hubs, such as Japan, Europe and North America, C&W has promoted, and benefited from, liberalization. C&W's Mercury Communications Ltd. was the first company authorized to compete with British Telecom. Mercury has achieved impressive shares of the private line, business long distance, and international telecommunications markets. In order to do so, it has had to fight to open markets and achieve operating agreements with the PTT monopolies of continental Europe. In the U.S.A., C&W has positioned itself as the competitor of AT&T, taking a stake in U.S. Sprint's transcontinental fiber optic network. C&W also gained entry to Japan because of pro-competitive policies. In 1985 the Japanese government moved to end the monopoly of KDD, its traditional international carrier. During these deliberations, C&W and the Thatcher administration were vocal advocates of permitting non-Japanese companies to own shares of the new, competing interantional carriers. Their demands for foreign participation were heeded; C&W now owns 16% of International Digital Communications (IDC), and 40% of the Japanese end of the NPC cable.

While it strives to compete in the world's "hubs," C&W has a different policy toward the world's "spokes." On the periphery of the world economic system, in small countries that were once the subjects of colonial powers, C&W has blocked competition by soliciting long term licenses giving it the exclusive right to provide domestic and/or international services. As was the case in Hong Kong, these licenses are made more attractive to the host governments by cutting them in on the deal. Table 1 is a listing of these arrangements in a few selected countries. Table 2 shows the country and the expiration date of C&W's exclusive licenses.

During a decade in which most suppliers in the developed world found the telecommunications business more competitive than ever before, C&W managed to win over 30 licenses protecting it from competition for extended periods of time. In one country C&W's license to provide domestic and international services runs until 2031. In Hong Kong, Antigua, and Fiji, C&W garnered 25 year exclusive contracts. In several other countries its licenses run for twenty years. In the majority of these cases, C&W holds the controlling interest. In the other cases, the host government retains majority ownership but still contracts with C&W to manage the system. In some cases, for example Grenada and Jamaica, C&W started out with a minority share but later acquired a majority. In several Caribbean nations it is 100% owner.

The consistency and motives of C&W's government partnerships are underscored by recent adjustments in the ownership of Hong Kong Telecommunications. With Chinese sovereignty over Hong Kong in 1997 on the horizon, C&W adroitly replaced the ownership interest of the outgoing British colonial administration with an equal-sized ownership share held by the PRC government. Early in 1990, C&W sold 20% of its shares in HKT to the Peoples Republic of China's state-owned overseas investment company, CITIC, while the Hong Kong Financial Secretary (part of the British government) sold half of its shares in HKT to the public and the other half back to Cable and Wireless.[10] CITIC's large ownership interest in HKT is intended to secure C&W's monopoly control of international telecommunications up to and after 1997.[11]

The Cable and Wireless modus operandi: analysis.

From the Table and the preceding discussion a common pattern emerges. It is to:

1)Enter into partnerships with the host governments of small countries;

2)Obtain majority ownership if possible; if majority ownership is not possible take a substantial minority share and seek to increase it later;

TABLE 1
CABLE AND WIRELESS GOVERNMENT PARTNERSHIPS
(Source: Cable and Wireless plc Annual Reports)

COUNTRY		
HONG KONG	*Telecommunications Administration*: Hong Kong Telecommunications (HKT) *Ownership*:	
	58.5%	Cable and Wireless plc
	20%	CITIC (China)
	21.5%	Public shareholders
	Licenses: Exclusive local voice services Exclusive all international services	
MACAU	*Telecommunications Administration*: Companhia de Telecommunicacoes de Macau S.A.R.L. *Ownership*:	
	55%	Cable and Wireless plc
	20%	CITIC (China)
	License: Exclusive for all local and international services	
MALAYSIA	*Telecommunications Administration*: Syarikat Telekom Malaysia *Ownership*:	
	49%	Cable and Wireless plc
	51%	Malaysian government
	License: Exclusive for all local and international services	
JAMAICA	*Telecommunications Administration*: Telecommunications of Jamaica (TOJ) *Ownership*:	
	59%	Cable and Wireless plc
	20%	Jamaican government
	21%	Public shareholders
	License: Exclusive for all local and international services	
GRENADA	*Telecommunications Administration*: Grenada Telecommunications Ltd. (Grentel) *Ownership*:	
	70%	Cable and Wireless plc
	30%	Grenada government
	License: Exclusive for all local and international services	
ANGUILLA	*Telecommunications Administration:* Cable and Wireless (West Indies) *Ownership:*	
	100%	Cable and Wireless plc
	License: Exclusive for all local and international services	

TABLE 2
C&W EXCLUSIVE LICENSES AND OWNERSHIP INTERESTS

Location	C&W interest %	Expiration of License International	Local
Asia and Pacific			
Cook Islands	100	1995	-
Fiji	49	2015	-
Hong Kong	58.5	2006	1995
Macau	51	2001	2001
Philippines	40	2002	-
Solomon Islands	41.9	2003	2003
Tonga	100	2000	-
Vanuatu	33	2009	2009
Western Hemisphere			
Anguilla	100	2018	2018
Antigua	100	2012	-
Barbadoes	60	1994	2002
Bermuda	100	1995	-
British Virgin Isles	100	2007	2007
Cayman Islands	100	1994	1994
Dominica	100	2005	2005
Falkland Islands	100	2010	2010
Grenada	70	2013	2013
Jamaica	59	2013	2013
Montserrat	100	2007	2007
St. Helena	100	2010	2010
St. Kitts and Nevis	80	2005	2005
St. Lucia	100	2001	2000
St. Vincent	100	2004	2004
Trinidad & Tobago	49	2009	2009
Turks & Caicos Isles	100	2013	2013
Middle East, Indian Ocean, and Africa			
Bahrain	20	2031	2031
Bangladesh	49	(19 years)	-
Diego Garcia	100	2011	-
The Maldives	51	1998	1998
Seychelles	100	2010	2010
Yemen Republic	65	1999	-

Source: Cable and Wireless plc
Annual Report on Form 20-F, 1989-90

3)Use the government-business partnership to secure long-term protection from competition;

4)Integrate the ownership of the domestic and international networks.

5)Use monopoly profits from international services to finance the development of a first-class local infrastructure.

This pattern should be of interest to telecommunications policymakers and economists for the following reasons. The emergence of competition in the U.S. interexchange market in the 1970s sparked a series of debates about the proper pricing of telecommunications services. The outcome of this debate runs counter to the C&W model. The victorious view was developed and expounded most forcefully by Alfred Kahn, the justifiably renowned regulatory economist who served on the New York Public Service Commission and later presided over airline deregulation as head of the Civil Aeronautics Board during the Carter administration. Kahn demolished the economic rationales for the classical cross-subsidy between long distance and local exchange service and propounded a new orthodoxy.[12] The essential elements of this view were that a) terminal equipment should be unbundled from exchange access; b) non-traffic sensitive access costs should be recovered via a flat charge and separated from usage costs; and c) prices for interexchange usage should be based on the incremental cost of supplying long distance links, and should not be used to recover any of the costs of the local network.

Re-examining Kahn's views in the light of C&W's global development leads to some interesting conclusions. The first element--that terminal equipment should be unbundled from network services--is no longer a matter of debate. It is being implemented with successful results virtually everywhere in the world. But for elements b) and c) the case is not so clear. They may be good economics once a developed, universal network is in place. But they may not be good business practice in the developmental stages of a telecommunications infrastructure. It is widely recognized in the economic literature that the presence of network externalities, the need to attain a "critical mass" of users, may make it necessary to subsidize access costs in the initial phases of a network's development.[13] When access is subsidized, it is necessary to recoup the subsidy by overpricing some other aspect of the service, usually usage. In the case of Cable and Wireless, of course, exchange access is subsidized via monopoly control of international telecommunications. In some ways this does not contradict Kahn's views. Kahn asserted that competition penalizes cross subsidization by driving prices toward actual incremental costs. C&W has dealt with this problem by eliminating the possibility of competition via long term exclusive licenses.

Two important questions remain, however. First, do small countries such as Grenada, Jamaica, or Macau gain more by going along with the C&W approach in order to build up their local telecommunications infrastructure than they lose from the potential benefits of competition? Remember, these are developing countries, not advanced, high-penetration telecommunications systems such as exist in the U.S. and Japan. There is no attempt to answer this question here; my purpose is simply to pose it.

Second, does competition during the developmental phase of a network really drive all prices toward incremental costs? The evidence suggests that it ain't necessarily so. Many businesses (on-line information services, satellite broadcasters, videotext and video games suppliers) currently engage in the practice of underpricing or subsidizing access equipment costs and recouping the subsidy through usage. The success or failure of this strategy does not seem to hinge on whether the market in question is competitive. The most powerful evidence, however, comes from the history of the U.S. telephone system itself. In the early 1900s, AT&T was engaged in a competitive race with independent telephone companies. Since the competing networks were not connected, both systems gained an advantage by attempting to make their systems as widespread as possible. During this period AT&T built exchanges in many small locales and consciously charged less than remunerative prices for exchange access. AT&T more than made up for the subsidy by toll usage charges. The extension of exchange access increased the value and usage of the toll service by increasing the number of subscribers that toll users could reach.[14] This was done in an environment that was highly competitive--more so than today's telecommunications marketplace, in that more than 50% of American cities over 5,000 in population had two local exchanges, and many cities had no rate regulations or restrictions on entry. In this case, unrestricted systems competition rewarded firms which underpriced access and charged premiums for toll usage.

At this point I should make it clear that I am not an apologist for, or even an advocate of, the Cable and Wireless approach. Indeed, the author has published severe criticisms of the ill effects of the Hong Kong monopoly on international telecommunications.[15] However, the integrated development strategy should be analyzed objectively for its theoretical and practical significance, not rejected out of hand for inappropriate reasons. Like the AT&T of the early 1900s, C&W and its government partners apparently view modernization and expansion of local exchange networks as an integral part of the growth and success of long distanc (i.e. international) telecommunications. Perhaps the international telecommunications infrastructure is still in the system-building phase, wherein access subsidies have some place.

How successful this strategy will be in the long term, and whether it can even survive the prevailing centrifugal forces dominating telecommunciations remains to be seen. This analysis contains no empirical evaluation of the effects of the C&W modus operandi on its client states. We do not know whether this method will help them to develop strong, self-sustaining, technologically advanced local networks, or simply line the pockets of C&W's shareholders with monopoly profits. The jury is still out.

REFERENCES

[1] See for example, Eli Noam, "Network Tipping and the Tragedy of the Common Network: a theory for the formation and breakdown of public telecommunications systems." (New York: Center for Telecommunications and Information Studies, 1990).

[2] Hugh Barty-King, Girdle Round the Earth: the story of Cable and Wireless and its predecessors to mark the group's jubilee, 1929-1979. London: Heinemann, 1979).

[3] See "Hot line to C&W in the Tories public call-box," The Economist, October 24, 1981, p. 79; "Cutting the Cable," Far Eastern Economic Review, July 3, 1981, p. 54. In contrast to the privatization of British Telecom, the semi-privatization of C&W has received very little attention from economists and policymakers. The semi-privatization occured simultaneously with the deal with the Hong Kong government which gave C&W a 25-year exclusive license over the colony's international telecommunications, and thus was almost certainly orchestrated at the highest levels of government.

[4] In April 1990, CWHK changed its name to Hong Kong Telecommunications International.

[5] Hong Kong Telecommunications has played a crucial role in the C&W strategy. Despite the large number of countries in which it operates, C&W was heavily dependent upon its Hong Kong operations for profitability during the 1980s. In 1989, HKT accounted for only 58% of the C&W group's total revenues but produced 75% of the group's total profits. HKT's share of total profits was even higher from 1986 to 1988, when C&W's Mercury property was operating at a loss. During those years HKT accounted for 82% to 85% of C&W's total profits. In effect, for the past ten years profits from Hong Kong have financed C&W's global expansion. The high profitability of HKT is in turn attributable to Cable and Wireless's exclusive license on international telecommunications.

[6] Although many interests are involved, C&W is one of the dominant forces in the H-J-K cable. It is a joint venture of Japan's KDD (35.8%), Korea's KTA (19.6%), AT&T (8%), Telecoms of Singapore (1.2%), and several smaller investors.

[7] Cable and Wireless is even more dominant in the ASPAC consortium. ASPAC is a partnership of C&W, the Telecommunications Authority of Singapore, IDC of Japan (16% owned by C&W), and Mercury Communications Ltd. (100% owned by C&W).

[8] Dawson Walker, Head of Competitive Strategy, Cable and Wireless. "New Directions in Network Development," Proceedings of the Second International Telecommunications Futures Symposium, (Omaha: ICTM, 1990).

[9] "The Grentel Experience," A Talk by Mr. Ray Smith, Chairman Grenada Telecommunications Ltd., at the Cable and Wireless Managers Conference. Printed in CANTO, the quarterly review of the Caribbean Association of National Telecommunications Organizations, Vol 6 No. 1, January-March 1990.

[10] C&W has taken the exact same route in Macau, another former colony which will be returned to Chinese sovereignty in 1999. C&W also enjoys a long term exclusive license there, and has sold a 20% interest to CITIC.

[11] CITIC will use its economic and political muscle to directly influence the course of telecommunications policy in the territory. Any doubts about this were dispelled in late June, 1990, when CITIC intervened on the side of HKT during negotiations with the government over increases in local telephone rates. A strongly worded letter from CITIC's Executive Director, Rong Zhi-Jian, to the Hong Kong Financial Secretary asked the HK government to end its freeze on local telephone rates. "A letter from Rong Zhi-Jian to the Finance Department..." Overseas Chinese Economic Journal, June 25, 1990. CITIC has also indicated that it will strongly oppose any attempt to introduce competition in international services: "Under no circumstances can a second network be allowed to cut into HK Telecom's international business before the expiry of the international franchise in 2006"--CITIC managing director Larry Yung, quoted in Dont be unfair to Telecom--CITIC, South China Morning Post, September 27, 1990.

[12] Kahn's views are summarized in Alfred Kahn, "The next steps in telecommunications regulation and research," Public Utilities Fortnightly, July 19, 1984.

[13] For the underlying economic theory see Jeffrey Rohlfs, "A theory of interdependent demand for a communications service," Bell Journal of Economics and Management Science, Spring 1974. See also Noam, "Network tipping..." note 1 above, and Godefroy Dang-Nguyen, "Vertical and horizontal relationships in telecommunications markets," (Omaha: ICTM).

[14] Milton Mueller, "The Telephone War, Interconnection, Competition and Monopoly in the Making of Universal Service," Ph.D. dissertation, University of Pennsylvania, Annenberg School of Communications, 1989.

[15] Milton Mueller, International Telecommunications in Hong Kong: the case for liberalization. (Hong Kong: the Chinese University Press, 1991).

A LEGAL OVERVIEW OF THE INTERNATIONAL ADMINISTRATION OF GEOSTATIONARY ORBITS: DO THE LDC's NEED THE IFRB?

by

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ABSTRACT

This paper examines the exercise of power by the IFRB from the perspective of two case studies, TV Marti and Tongasat. In each case the IFRB has applied its version of the "spirit and intent" of the Convention and the Regulations to reach judgment with regard to a dispute. At issue in both cases is the scope of the IFRB's authority.

1. INTRODUCTION

The communications satellite industry is regulated at ... the international level: .. there are two types of governance, the frequency and orbital slot assignments undertaken by the International Telecommunications Union (ITU) and its International Frequency Registration Board (IFRB), and the global requirements imposed by the INTELSAT agreement.[1]

The governing rules of the ITU are contained in the Convention and the Regulations. The Convention is the organization's basic document. It specifies the terms and conditions by which ITU functions, its relationship with other organizations such as the United Nations and other functional matters.

Regulations, drafted by administrative conferences, are the detailed rules of operation. Each member country is bound when it signs the convention or regulations except as to any provisions which it notes as unacceptable. The IFRB interprets and applies the radio regulations.

A geosynchronous satellite has the same period of rotation as the earth about its axis.[2] A geostationary satellite is a geosynchronous satellite travelling in a circular orbit lying in the plane of the earth's equator.[3] The geostationary satellite maintains an altitude of approximately 22,300 miles and is relatively stable to terrestrial observer at a fixed position. This allows earth stations to continuously transmit and receive data from the satellite without tracking equipment.

Fifteen percent of the world's population accounts for 90 percent of all telephones in use, 80 percent of all calls originate or terminate in the USA, and there are more telephones in the city of Tokyo than in the whole of Africa.[4] Satellite communications are an attractive means of serving telecommunications needs in undeveloped areas at a reasonable cost.[5] Many lesser developed countries (LDC) rely on existing International and Regional networks to provide satellite service to them.

3. Common User Associations

3.1 International

INTELSAT was founded in 1964 by 11 countries to provide international communications services. INTELSAT launched its first satellite, "Early Bird" into the GSO in 1965.[6] Twenty-seven countries now use INTELSAT for domestic telephone services. An average pricing system over all routes is applied. High traffic routes subsidize routes with lower traffic density.

INTERSPUTNIK was formed in 1972 by the USSR and its allies in direct response to the strong American influence of INTELSAT. INTERSPUTNIK has fourteen members and several nonsignatories use it for communications with member states. Although its rates are lower than INTELSAT's and each member has one vote, the group has failed to forge a serious challenge to INTELSAT. However, it has been noted that an increase in INTELSAT rates combined with better technology may increase INTERSPUTNIK's viability.[7] The Soviet Union's own domestic communications satellites, the GORIZONT system, also leases capacity to other countries.[8]

The International Maritime Satellite System (INMARSAT) was formed in 1972. INMARSAT provides communications facilities to the shipping and offshore communities and is beginning to provide mobile satellite services to both land and offshore facilities. One of its latest services is to provide telephone calls from commercial airplanes.[9]

3.2 Regional

The European Communications Satellite (ECS), operated by the European Telecommunications Satellite Organization (EUTELSAT), provides telephone, telex and specialized services traffic capacity to the PTTs of the European Conference on Posts and Telecommunications (CEPT) and also television distribution between the countries which form the European Broadcasting Union (EBU).[10]

ARABSAT was formed in the early 1980's to provide means of communications to the 22 member counties of the Arab League.[11] The proposal for the establishment of the this regional system stated that it was in compliance with Article XIV of the INTELSAT agreement because the system would not cause severe economic harm to INTELSAT for the reason that much of the traffic was new. In addition, the Arab states indicated they would build a terrestrial link if the proposal was rejected.[12] It is an example of a system enhancing regional cooperation and improving the telecommunications system of the individual nations.[13]

The Palapa system was proposed by President Soeharto in 1972 to increase the standard of living in Indonesia and provides service to Indonesia's 13,677 islands. INTELSAT recognizes Palapa as a regional system which is owned by Indonesia but utilized by the Philippines, Malaysia, and Thailand.[14]

4. Emergence of competitive systems

4.1 Private

As a result of deregulation of AT&T and of PTTs in UK and Japan, there have been a number of proposals for the establishment of privately-owned international satellite systems which would compete with and complement INTELSAT.[15] At present "..there is one operational international separate system, PanAmSat, with two satellites, and one recently approved separate system, Orion, with two planned satellites."[16] "PanAmSat has asked the FCC to lift the ban on separate satellite networks in general [and] specifically to permit [switched network] connections to Eastern Europe."[17] "Three joint ventures have been established to provide private satellite telecommunications services in Japan. All three are in cooperation with U.S. companies. Only two have been approved by MPT [Japan's Ministry of Posts and Telecommunications], which refuses to approve the third because of 'insufficient demand'".[18] Columbia Communications Corp. plans to begin offering service in the Atlantic and Pacific regions next year.[19]

4.2 National

The trend toward nations owning and operating their own satellite telecommunication system arose in the 1970's and continued into the 1980's. Countries which have launched or plan to launch domestic telecommunication satellites include the USSR, Canada, France, the United Kingdom, Japan, Brazil, India, Italy, the Nordic countries and Indonesia.[20]

"In April 1990, the Brazilian Ministry of Communications awarded the contract for Brasilsat II to Hughes. The two satellites, worth $155 million, will be used for fixed and mobile satellite services (voice, video, etc.) as well as for military applications."[21]

"The Turkish PTT chose a European consortium lead by Aerospatiale of France for the construction of a complete telecommunications satellite system to be called Turksat."[22]

5. The Concern of the LDCs

The development of alternate satellite networks leads to competition in the provision of satellite services. Increasing development results in a diminishing supply of available satellite positions in the GSO. Private systems concentrate on high density routes thus impair INTELSAT's ability to use average pricing in order to provide low cost service to under developed regions of the world.[23] "The questionable enforceability of the present ITU rules has also worried the developing countries."[24] The LDC in particular have been concerned that satellite locations will not be available in the GSO to serve their needs and have demanded equitable access to the GSO and related spectrum.[25]

5.1 Allotment Plan

The 1985 Space WARC was the first of two sessions which addressed the LDC demand for equitable access. The first session outlined an allotment plan for fixed satellite communication services to provide each administration with "an orbital position in a predetermined arc; a bandwidth of 800 MHz within the expansion bands selected; and a service area."[26] The objective of the plan was to guarantee all countries equitable access to the GEO. The plan was adopted in the second WARC session in 1988. The key factor mitigating against the viability of this plan appears to be inability to attract capital for the construction of a limited use system. The LDC is not prevented from entering into a sharing arrangement with others to create a sub-regional system using allocated spaces. It remains to be seen whether such arrangements are possible or viable from an investment point of view.

6. ROLE OF THE IFRB

6.1 Registrar, Mediator or Regulator?

Although six essential duties are listed in the Convention, the primary basis for the existence of the IFRB is defined in its first duty, to record and register radio frequencies with the intention of establishing international recognition of the frequency.[27]

> The procedures governing notification and registration of frequency assignments in the Master International Frequency Register may be broadly subdivided into the acts of coordination, notification, examination and registration....if the Board finds that there is a probability of .. interference, the notice is returned to the notifying administration..If the Board finds that there is little or no probability of harmful interference..the assignment is entered in the Master Register, accompanied by all relevant remarks, which establishes the legal status of the assignment vis-a'-vis other existing and future assignments. [28] (Emphasis added)

The authors surveyed a group of international scholars regarding telecommunications systems in space and the appropriate role for regulators in this decade. We received five responses to these questions:[29]

1. What is the appropriate role for international satellite consortiums such as INTELSAT?

   Our sense is that the respondent's from Asia and South America feel that global telecommunications at reasonable rates including subsidies without competition from private systems is the most important role for INTELSAT. However, Mr. Martin-Lof, Swedish Telecom, feels that competition is established and that INTELSAT must use the most advanced technology available to provide interconnectivity to its users.

2. What is the appropriate role for regional satellite systems such as ARABSAT and PanAmSAt?

   Mr. Djiwatampu distinguished public regional systems such as ARABSAT from private regional systems such as PanAmSat. There was no general consensus as to their role. The views crossed the entire spectrum with regard to private networks, i.e. Mr. Djiwatampudo would not allow private competition to Mr. Johan Martin-Lof allowing free competition.

3. What is the appropriate regulatory role for the ITU and IFRB?

   There was a consensus that the ITU needs to be independent of the large consortiums, although INTELSAT was not single out in any single response. There seemed to be a common thread in each response that the IFRB should make technical decisions in a more professional manner and treat all nations equally.

7. Two case studies

7.1 TV Marti

There has been a running dispute between Cuba and the United States involving telecommunications law for several years. There are two prongs to the dispute. First, the United States intentionally broadcasts information into Cuba on frequencies not used domestically in Cuba. Second, Cuban stations are causing harmful interference to United States broadcast stations in Florida. The most recent flare up involves TV Marti, a spanish language television station at Cudjoe Key in Florida, which uses a directional antenna mounted on a balloon at an elevation of approximately 10,000 feet to send its television signal to Cuba. This broadcast is capable of "reaching nearly half of the Cuban population."[30]

On November 3, 1989, Cuba complained to the ITU that TV Marti intended to use "frequency bands allocated to our national broadcasting services for the purpose of beaming transmissions to our country." On April 2, 1990, the IFRB advised the United States that the operation of TV Marti "is in the view of the Board not in compliance with the intent and spirit . . . of the Radio Regulations" and requested that the U.S. eliminate "this harmful interference." One official of the U.S. State Department was then quoted as stating that the IFRB's "primary function" is registration of uses of the spectrum, "not adjudication."[31] On March 27, 1990, the U.S. submitted its "notification of TV Marti assignment and [was] confident the IFRB [would] process the notification under clearly established provisions of the radio regulations."[32] Instead, on September 3, 1990, the Board concluded that the Cudjoe Key station was not in conformance with the Convention and the Regulations and returned the notification.

The U.S. position is that the TV Marti frequency, although registered by Cuba with the IFRB, is not actually used in Cuba and thus there was no "interference" as the basis for IFRB involvement in the dispute.[33] Furthermore, the U.S. contended, in the event of interference, the Board's authority is limited to "advice and assistance."

The Board rejected this view and construed its authority "to perform any additional duties, concerned with the assignment and utilization of frequencies . . . in accordance with the procedures provided for in the Radio Regulations"[34] as the basis for its demand that the U.S. cease TV Marti transmissions to Cuba. The U.S. responded that the provision relied on by the IFRB is limited to its duties regarding conferences and "does not grant authority to the Board to assume whatever additional duties it deems appropriate based on its own interpretation of the Radio Regulations."[35]

The Convention lacks specific guidelines regarding the United States' action of transmitting across national borders without specifically causing harmful interference to another state's use of its broadcast frequency. As a general principle, short wave band frequencies are the accepted method for transmission across boarders rather than commercial broadcast frequencies.[36]

The harmful interference caused by Cuban broadcast stations is however, addressed by the ITU's radio regulations. The ITU Convention provides that member administrations avoid harmful interference with each other.[37] As long as the TV Marti signal is not causing actual interference to a Cuban broadcast station such provisions would not appear to apply to that prong of the dispute.

The ability of the ITU to resolve a dispute is questionable. Article 50 of the Convention is the relevant to dispute resolution between administrations.[38] However, the convention and its regulations cannot be used to resolve a dispute unless the parties to the dispute agree or the parties are signatories to an Optional Additional Protocol to the International Telecommunications Convention, Nairobi, 1982 titled "Compulsory Settlement of Disputes."[39]

7.2 TongaSat

TONGASAT filed advance information notifications and coordination requests with the IFRB for a satellite network at twenty-two different GSO positions. These filings effectively fill the remaining GSO arc positions from India, 73.5 degrees E longitude, through South East Asia and Australia to Hawaii, 172.5 W longitude.

The United States (as the notifying administration for INTELSAT), Cameroon, Colombia, Peru, Syria and Turkey (INTELSAT Group) claim that TONGASAT filed for a large number orbital positions and frequencies[40] "for financial speculation."[41] The INTELSAT Group allege TONGASAT's action violates Article 33 of the Convention, Radio Regulation 339, and Resolutions 2 and 4 of the 1979 Space WARC in Geneva and requested the IFRB "to refuse to recognize TONGASAT's filings."[42] Not mentioned in its letter to the IFRB is the fact that INTELSAT is attempting to coordinate a GSO position at 174.0 W longitude in the C band frequency with full knowledge that TONGASAT has previously filed for a position at 172.5 W longitude also in the C band. If TONGASAT loses international protection from harmful interference, INTELSAT will prevail in the contention for this position. This would be particularly egregious because the disputed position is directly over the Kingdom of Tonga.

The stated goal of TONGASAT in occupying these slots is to construct a six satellite regional system serving the Pacific Rim. It admits that it overfiled but contends that the difficulty of coordination required the filing for alternate positions. On November 2, 1990, the IFRB notified the Kingdom of Tonga that TONGASAT must reduce the number of coordination requests to a maximum of six by January 1991.[43] The IFRB uses two Regulations as the basis for its action. Regulation 996 allows "the review of entries in the Master International Frequency Register with a view to amending or eliminating, as appropriate, those which do not reflect actual frequency usage, *in agreement* with administrations which notified the assignments concerned."[44] (emphasis added).

The IFRB ignores the fact that Radio Regulation 996 requires IFRB action to be contingent upon agreement with the notifying administration, Tonga in this case. An interpretation in accordance with the plain meaning of the text would indicate that any IFRB action to amend or delete any of the TONGASAT filings must be with the agreement of the Kingdom of Tonga.

The IFRB also cites Regulation 1564 contained in Article 13 as an additional source of authority to review the TONGASAT filings.[45] Regulation 1546 authorizes to findings in the Master Register *sui sponte*. In this case, it is not clear that the Board has made any findings to date. If no findings have been made, then this is not a valid basis for review.

Neither of these Regulations form a basis for IFRB action. There has been no agreement with the Kingdom of Tonga regarding this action, it is a unilateral action by the Board, and the Board has not made findings related to the TONGASAT notices at the time of the letter.

Having found that it is empowered to act, the IFRB turns to paragraph 154 of the Convention and Radio Regulation 339, which provide that administrations "shall endeavor" to use the minimum number of frequencies necessary to provide the planned services. The Board assumes as a fact that TONGASAT has not endeavored to use the minimum number of frequencies necessary to provide the planned service. The IFRB then interprets "shall endeavor" to be to be a mandatory "shall." Clearly the text "shall endeavor" does not require that administrations use the minimum number of frequencies. Use of the minimum number frequencies is merely an "objective" of the administrations in determining their own requirements.[46]

In addition, section 2 of Article 33 (number 154 of the Convention) should be construed to favor TONGASAT in a coordination dispute with INTELSAT. The Kingdom of Tonga, the administration acting on behalf of TONGASAT, clearly falls within the category of a developing country while the United States, the administration acting on behalf of INTELSAT, is just as clearly a developed country. TONGASAT is not in the same position as INTELSAT economically to use cutting edge technology which might allow more flexibility in using the GSO. While the disputed GSO positions are clearly in the Tonga region, they are not within the region of any of the complaining administrations and would appear to only marginally affect INTELSAT planned networks.

Thus, we conclude that the IFRB letter of November 2, 1990 regarding the planned TONGASAT satellite system was not based upon the plain meaning of the Convention or Radio Regulation text and appears to go beyond the limited grant of authority given the IFRB by the Convention. It is also interesting to note that the IFRB letter of November 2, does not take notice that the United States on behalf of INTELSAT would have the opportunity comment on the published information under Radio Regulation 1047.[47]

If the Kingdom of Tonga does not reduce its filings to a maximum of six by January 1991, the Board threatens to review all of the separate TONGASAT filings. Implicit in such threat is the warning that the IFRB intends to find that none of the TONGASAT filings conform with the Convention or Regulations and are not entitled to protection from interference from other administrations.

This threatened action appears to be without precedent. In the past, the Board has penalized only those individual assignments which are not in conformity with the regulations. As an example, if one of the satellite networks administered by the United States does not comply with the regulations, only that network loses the benefit of international protection from harmful interference. If the Kingdom of Tonga does not comply with the Board's edict and the Board carries through with its threat to reject all TONGASAT networks, will such action establish a precedent for review of all unused GSO positions? Will the Board then review all United States networks based on the Kingdom of Tonga's allegation that there are ninety-seven unidentified USASAT networks?[48]

8. Remedies

What course of action is appropriate following a decision based upon an incorrect interpretation of the regulations by the Board? This question is discussed by Leive in his treatise on International Telecommunications Law.[49] Leive concluded that the arbitration procedure does not appear to cover a dispute between TONGASAT and the Board. In the typical case noted by Leive, "[T]he Board's findings impose no substantial injury: they can be rejected by the administration concerned."[50] As has been demonstrated above, that proposition is no longer true.

Subsequent to the 1970 publication of Leive's treatise, the 1979 WARC in Geneva adopted a resolution to resolve disputes between an administration and the Board over technical standards.[51] In November 1987 and March 1988, a panel of experts convened to review the future of the IFRB.[52] The panel report to the Administrative Council reached two important conclusions regarding the IFRB's functions. First, the panel stated "[T]hat an essential function of the Board was the interpretation of the provisions of the Radio Regulations where there were gaps or where the texts were ambiguous."[53]

Second, the panel concluded that even if a board decision may cause substantial economic harm to an administration, the regulations do not explicitly provide for an appeal process. However, a divided panel concluded that Radio Regulation 1001.1 and Resolution 35 of the 1979 WARC formed a sufficient basis to appeal a board decision based upon an interpretation of the regulations.[54] The problem should be referred first to the CCIR for resolution at the next CCIR Plenary Assembly. If the CCIR does not resolve the disagreement, it may be referred to the agenda of the next Administrative Council for final resolution.[55] The jurisdiction of the International Court of Justice to resolve ITU disputes is untested.[56]

As a result of the INTELSAT filing for a position which will cause harmful interference to TONGASAT, a ruling by the Board may result in substantial injury to the Kingdom of Tonga. Thus it would appear that the Kingdom of Tonga is forced to begin the appeal process specified in Resolution 35. It is unclear whether or not the Board's interpretation remains effective pending appeal. It would be patently unfair to allow INTELSAT to continue coordination proceeding while TONGASAT's proceeding's are stayed. In the instance of Cuba, the IFRB's decision is of no practical effect at this moment in time. To be consistent, however, the IFRB should extend the logic applied in the TONGASAT case to TV Marti and threaten to strip the United States of international protection for its broadcast frequencies in order to enforce what the IFRB believes to be the "spirit and intent" of the Convention.

9. Conclusion

Whether or not one agrees or disagrees with the equitable merit of the IFRB decisions in TV Marti and Tongasat, two points are absolutely clear. First, the findings of the IFRB should not be given the weight of law. Second, a mechanism for the resolution of disputes between administrations should be established within the framework of the Convention.

The authors wish to thank the following individuals who generously responded to our request for information: Mr. Arnold Ph. Djiwatampu, Deputy Director for Telecommunications, Indonesia; Mr. Carlos Haramoto N., Assistant Manager of Planning and Development, Compania de Telefonos de Chile; Prof. M.V. Pitke (personal views), Tata Institute of Fundamental Research, India; Johan Martin-Lof, Director International Affairs, Swedish Telecom; and Dr. W von Noorden, General Counsel, International Maritime Satellite Organization; and Mr. Richard E. Shrum,

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Endnotes

1. G. Reynolds & R. Merges, Outer Space, Reynolds and Merges 199 (1989).

2. ITU Radio Regulations 180 (Geneva 1979).

3. ITU Radio Regulations 181 (Geneva 1979).

4. World Communications, 26 (ITU Telecom 1987).

5. Id. at 282.

6. Id. at 62.

7. G. Codding, The Future of Satellite Communication 48-50 (1990).

8. World Communications, 62 (ITU Telecom 1987).

9. *Id.* at 50-54.

10. Id. at 62 & 66.

11. Id. at 66.

12. *Id.* at 56-57.

13. Response by Mr. Djiwatampu, Deputy Director for Telecommunications, Indonesia, to author inquiry regarding role of regional systems.

14. Id. at 57.

15. The Telecommunication Industry, 63 (United Nations Publication 1987).

16. U.S. Telecommunications in a Global Economy: Competitiveness at a Crossroads, A Report from the Secretary of Commerce, 51 (August 1990).

17. Data Communications Magazine, October 1990, page 60, col. 1.

18. U.S. Telecommunications in a Global Economy: Competitiveness at a Crossroads, A Report from the Secretary of Commerce, 138 (August 1990).

19. Communications Week, October 8, 1990, page 37, col. 5.

20. The Telecommunication Industry, 62 (United Nations Publication, 1987).

21. U.S. Telecommunications in a Global Economy: Competitiveness at a Crossroads, A Report from the Secretary of Commerce, 122 (August 1990).

22. TE&M Magazine, October 15, 1990, page 31, col. 2.

23. The Telecommunication Industry, 63 (United Nations Publication, 1987).

24. Staple, The New World Satellite Order: A Report From Geneva, 80 A.J.I.L 699, 708 (1986).

25. Id.

26. M. Smith, International Regulation of Satellite Communication 94 (1990).

27. International Telecommunications Convention, Nairobi, 1982, art. 10 (1982).

Please note paragraph 4b, the IFRB Coordinates only geostationary satellites. It does not offer the coordination of position to telecommunications satellites in polar orbits or low earth orbits.

28. World Communications, 354 (ITU telecom 1987).

29. Arnold Ph. Djiwatampu, Deputy Director for Telecommunications, Indonesia; Carlos Haramoto N., Assistant Manager of Planning and Development, Compania de Telefonos de Chile; Prof. M.V. Pitke (personal views), Tata Institute of Fundamental Research, India; Johan Martin-Lof, Director International Affairs, Swedish Telecom; and Dr. W von Noorden, General Counsel, International Maritime Satellite Organization. Representatives from INTELSAT declined to respond to queries. Dr. W von Noorden responded with information regarding the future regulatory role of INMARSAT.

30. President pushes TV Marti; ITU pushes back, Broadcasting Magazine, April 9, 1990, page 38, column 1, quoting Congressman Larry Smith (D-Fla).

31. Id., page 37, column 3.

32. Id., page 37 to 38, columns 3 & 1 respectively.

33. "TV Marti is not being a bad boy by transmitting on an empty channel at an empty hour." Antioni Navarro, director of TV Marti. Discussion of TV Marti untethers strong reactions, Broadcasting Magazine, April 9, 1990, page 43, column 2.

34. No. 80 (CON) adopted at the International Telecommunication Convention (Nairobi 1982).

35. Letter from Kenneth W. Bleakley, Acting U.S. Coordinator, Bureau of International Communications and Information Policy, U.S. Department of State, dated July 9, 1990, to G. C. Brooks, the Chairman of the IFRB.

36. Comment, *Radio Marti and the U.S. - Cuban Radio War*, 36 Fed. Com. L.J. at 89.

37. International Telecommunications Convention, Nairobi, 1982, art. 35 (1982).

38. International Telecommunications Convention, Nairobi, 1982, art. 50 (1982).

Article 50, paragraph 2 references Article 82 titled "Arbitration: Procedure." This procedure will not function when one of the parties to the dispute fails to appoint an arbitrator or participate in the arbitration procedure. Id. at art. 82.

39. Optional Additional Protocol to the International Telecommunication Convention (Nairobi, 1982) Compulsory Settlement of Disputes.

The United States, Cuba and the Kingdom of Tonga are not party to this protocol.

40. TONGASAT filed for both C band (4-6 GHz) and the Ku band (12-14 GHz) in the majority of the requested slots.

41. ITU Radio Regulation 1047.

While the individual complaining administrations are members of the ITU. It is unclear whether they should have standing to complain even in a quasi-judicial function because none of the individual administrations are within the proposed service of the system. Thus, none of the individual complaining administrations appear to suffer any actual harm by the proposed TONGASAT regional system. The approximate location coordinates of each of the complaining administrations are Cameroon (10E, 5N), Colombia (75W, 5N), Peru (75W, 10S), Syria (40E, 35N), and Turkey (35E, 40N).

Assuming arguendo, that INTELSAT is correct, there is no prohibition in the Convention or Regulations against such filing and "the right to sell or rent a geostationary orbital position allotted in a plan has been discussed in the literature. See Mecklin, Management of the Frequency Spectrum, Wash. U. L. Q. 26 (1968); Wihlborg & Wijkman, Outer Space Resources in Efficient and Equitable Use; New Frontiers for Old Principles, XXIV The Journal of Law and Economics 23 (1981)." International Regulation of Space Communication, Smith, p. 54, fn. 41 (1990).

42. June 8, 1990 letter from Dean Burch, Director of INTELSAT, to Mr. Pekka Tarjanne, Secretary General of the ITU.

43. Letter from IFRB chairman, V.V. Kozlov, to Mr. Sione Kite, Deputy Chief Secretary & Deputy Secretary to Cabinet for the Kingdom of Tonga.

44. Chapter IV, Article 10, section 2 (e), ITU Radio Regulations, Geneva, 1979.

45. Article 13 Notification and Recording in the Master International Frequency Register of Frequency Assignments to Radio Astronomy and Space Radiocommunication Stations Except Stations in the Broadcasting Satellite Service

Section V. Review of Findings
1561 Section 23 (1) The review of a finding by the Board may be undertaken:
1562 a) at the request of the notifying administration;
1563 b) at the request of any other administration interested in the question, but only on grounds of harmful interference;
1564 c) on the initiative of the Board itself when it considers this is justified.

46. *See*, M.L. Smith, International Regulation of Satellite Communication 45-47 (1990); Endeavor - To exert physical and intellectual strength toward the attainment of an object. A systematic or continuous effort. Black's Law Dictionary 473 (5th ed. 1979).

47. However as there is no indication that any of the proposed networks would cause harmful interference to Cameroon, Syria, Turkey, Colombia or Peru, they would not have a basis to comment on the proposed networks.

48. November 11, 1990 Fax to Mr. Alfred Sikes, Chairman of the FCC from Mr. Sione Kite, Chief Secretary to the Cabinet, Kingdom of Tonga.

49. D. Leive, International Telecommunications and International Law: The Regulation of the Radio Spectrum 300 (1970).

50. *Id.*

51. Resolution 35 titled "Relating to a Procedure for Resolving a Disagreement over the technical Standards or Rules of Procedure of the International Frequency Registration Board." ITU Radio Regulations (Geneva 1979).

52. A Review in Light of Changing Circumstances of the Long-Term Future of the International Frequency Registration Board; Final Report of the Panel of Experts to the Administrative Council (Panel of Experts Report). This panel was convened pursuant to Resolution 68 of the Plenipotentiary Conference, Nairobi, 1982.

53. *Id.* at 18.

54. *Id.* at 19 & 28-29.

55. ITU Radio Regulations, Resolution 35 (Geneva 1979).

56. Staple, The New World Satellite Order: A Report from Geneva, 80 A.J.I.L. 699, 709 (1986).

CHANGING ROLES FOR REGIONAL MEMBERSHIP ORGANIZATIONS

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Abstract

Regional membership organizations play a vital role in promoting and assisting various parts of the telecommunications environment as it undergoes rapid change. Paralleling the growth of telecommunications has been the establishment, restructuring and growth of both existing and new general and special telecommunications focussed non-profit membership organizations. What functions these organizations now plan, what changes they are undergoing to adapt to the new environment and what the future may hold is examined in this paper. In particular, the configuration of a new regional inter-organization will be discussed; it is tentatively named: FORA Pacific.

1. TELECOMMUNICATIONS IN THE PACIFIC

During the past decade, many countries in the Pacific have adopted policies which favor rapid development of telecommunications facilities. For example, recall the introduction of competition in Japan, privatization in Malaysia, revised government policies in Australia, and radical structural changes in New Zealand. These shifts have been accompanied by debates about whether telecommunications should be viewed primarily as a national good or as a profit center.

Taken together, these rapid shifts in government telecommuniations policy, the high rate of growth in telecommunications infrastructure and advancement in technology along with new applications of information systems and services all serve to create a great deal of uncertainty. The old realities of only a few years ago have given way to new corporate strategic alliances along with frequent ownership and personnel changes.

New technology and its region-wide application pushes for the rapid creation of new standards and places pressure on the allocation of the telecommunication spectrum. New capacities in region-wide long haul and in local loop systems raise connected questions of access and appropriate tariffs. The rising awareness in the Pacific of the economic importance of having an adequate telecommunications infrastructure brings to the fore questions of funding and of national and regional priorities. Of growing importance is the asociated need for human resources development. Where are the skilled information industry workers going to come from?

In face of these many uncertainties, a number of organizations have been established to provide for the sharing of information, for consensus building, and for the creation of reference points -- focal points -- for the systematic checking of this emerging reality.

Illustrative of the increased attention being accorded international organizations has been the recent spate of re-assessments on the part of such entities as the ITU through the "High Level Committee;" the recent ESCAP internal review; an outside consultants review of the Telecom Programme of the South Pacific Forum as well as a reassessment of the Asia-Pacific Telecommunity.

2. ROLES FOR REGIONAL ORGANIZATIONS

The way individual nations approach telecommunications development often transcend national boundries and become regional issues. Current discussions, for example, focus on the need for multinational investment, for regional training, for common standards and for easy connectivity. The potentially conflicting roles of new regional satellite systems with those of established global systems continues to be a topic of debate. Planning for additional undersea fiber links continues to make news in the region. This is compounded by the lack of a cohesive planning venue combining both undersea cable and international satellite systems.

Access to the network as well as to the information content it carries are of growing to concern to all entities of the Pacific Region.

How are all these issues managed? Is there a single system in place which allows for orderly debate, information sharing, and conflict resolution? Are there mechanisms in place which allow an easy transfer of resources, once a consensus is reached? The obvious answer is: no. At least, not yet.

However, there has developed a loose grouping of regional membership organizations which have been created and continued to address various aspects of these broad concerns. The fact that they exist is a tribute to the many professionals who work with acknowledged success in this environment and to the thousands who volunteer time and provide monetary and other resources to these groups.

One of the little appreciated functions of the regional organizations is that they provide a vital connection to the international organizations active in the telecommunication field, notably the International Telecommunication Union (ITU). The ITU provides a mechanism for developing international agreements on vital matters such as radio frequency assignments, satellie orbit allocations and communication standards. Geneva-based, this one-and-a- quarter century old United Nations organization facilitates planning and negotiations among all member governments on matters pertaining to standards for telecommunication transmission.

Other bodies that play a role in international standard setting, and thereby impact on the Pacific, include the International Standards Organization (ISO), Electronics Industry Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and various national standards bodies. Currently, the most notable standards setting efforts are in the areas of integrated services digital networks (ISDN) and high definition television (HDTV).

The ITU has also become engaged through its Center for Telecommunications Development (CTD) in persuading governments and industry of the necessity for more investment in the telecommunications infrastructure in developing countries. This effort runs parallel with a long-standing ITU program in technical assistance. Several of the regional organizations in the Pacific are closely associated with the ITU.

By one recent count, there are now some 80 organizations with a dual interest in telecommunication and the Pacific region. These membership organizations are non-profit and either non-governmental or inter-governmental. For the most part, they are professional associations primarily providing needed services to their own members. Four of these organizations with headquarters in the Pacific-Asia will be discussed below and several other organizations will be noted. Further details can be found on these and other organizations in the 1990 publication of the Pacific Telecommunications Council: "Non-profit organizations with Communication Interests in the Pacific Hemisphere."

The Asia-Pacific Broadcasting Union (ABU) was established in 1964 with current headquarters in Kuala Lumpur. Its primary objectives are to support the interests of member broadcasting organizations and to establish relations with other broadcasting unions; and, to study problems of broadcasting and ensure timely exchange of information. The ABU organizes exchange of radio and TV news by satellite among members along with joint productions. Seventy-five broadcasting organizations in the region are members. The ABU holds general annual meetings along with meetings of standing committees on programming and engineering matters and of specialized working parties and study groups. The Union publishes the ABU News and the ABU Technical Review.

The Asian Mass Communication Research and Information Centre (AMIC) was established in 1971 with present headquarters in Singapore. Its central objective is to assist the development of the media and other means of communication in the region within the broad framework of continuing education, economic, social, and cultural changes. AMIC is developing a major data bank related to media develop in the Pacific and West Asia. Members are individuals, educational institutions, government agencies and non-profit organizations. AMIC holds an annual general meeting along with frequent seminars, training meetings and refresher courses. It publishes the quarterly Media Asia, monographs, occasional papers, and a bibliography series.

The Asia-Pacific Telecommunity (APT) was established in 1979 with headquarters in Bangkok. The APT's objectives are to correlate the planning and development of intra-regional telecommunication networks to meet immediate and future requirements; and, to promote the implementation of agreed networks and to assist within the region with national level development. Ongoing concerns are with technology transfer and training of telecommunications personnel. Membership is open to any state within the region which is also a member of the UN or a member of ESCAP. APT holds an annual meeting along with seminars, training programs and other means for exchange of information among specialized personnel. It publishes the bi-annual Asia-Pacific Telecommunity, seminar proceedings and a variety of reports.

The Pacific Telecommunications Council (PTC) was established in 1980 with headquarters in Honolulu. The objectives of the PTC are to provide a forum for the discussion and the interchange of information, ideas, and points of view regarding telecommunications in Pacific area, by bringing together a multi-facted, diverse body, including users, planners, and providers of equipment and services; and, to promote the general awareness of the varied telecommunication requirements to meet the needs of the people of the Pacific hemisphere. PTC membership is open to all for-profit (116 members) and non-profit (40) entities which have a direct interest in telecommunication in the Pacific Hemisphere. Individual membership is open to qualified professionals (116 from 24 countries). PTC holds an annual conference in January in Honolulu, mid-year seminars in Pacific area countries and ad hoc meetings in conjunction with other organizations. PTC publishes the proceedings of its annual conference, a monthly newsletter, a quarterly magazine Pacific Telecommunications, reports and books.

In addition to the general purpose organizations cited above, ABU, AMIC, APT and PTC, there are a growing number of specific-focus organizations and telecommunications projects as well as several ad hoc or study groups formed by more broadly based regional organizations.

In the first category are entities such as the Asia-Pacific Institute for Broadcast Development (AIBD). Co-located with the ABU in Kuala Lumpur, AIBD seeks to foster the development of professionals in the broadcast field and organizes extensive training activities. A single focus, ISDN, prompted the Japanese to establish the Asian ISDN Council (AIC) in 1987. Through working groups and discussion, this council seeks to provide for the development of digital communication in the Asian region.

An example of telecommunications-related projects of more generally-oriented organizations is the "Triple T" project of the Pacific Economic Cooperation Conference (PECC). Triple T refers to transport, tourism and telecommunications. A major report on this project was made at the PECC meeting this past November in New Zealand.

A quick overview of a few of the more visible governmental and non-governmental groups illustrate the diversity of such organizations. Goverment-based telecommunications membership organizations active in the Pacific area include the POSTEL committee of the Association of the South East Asian Nations (ASEAN); the Commonwealth Telecommunication Organization which has many members in this region; and the telecom program of the South Pacific Forum, which covers all of the independent Pacific Island nations.

On the non-governmental side we have the International Computer Communications Conference (ICCC) with a somewhat unusual structure, existing more as a "network organization" and conducting international conferences in various locations in the world, most recently in India.

INTUG, the International Telecommunication Users Group is headquartered in Europe but has several national branches and members in the Pacific Region; for example, consider the active Australian Telecommunication Users Group (ATUG). Finally, while based in London, the International Institute of Communication (ICC) holds some of its annual meetings in the Pacific region, has national chapters in Australia and Japan, and has many individual members in the region.

An observer of the organizations noted above will find a number of similarities in terms of structure and govenance, and discover a common set of activities that include conferences and publications. There are, however, wide differences in the topics addressed, and in the level of annual activity. One of the important differences is found in terms of the membership base -- non-governmental or inter-governmental. The chart below gives a rough breakdown on this dimension of a few of the entities studied.

ORGANIZATIONS HAVING TELECOMMUNICATION AS A MAJOR FOCUS

Intergovernmental	Private/NGO
ABU	AIC
APT	AMIC
ASEAN POSTEL	ICCC
CTO	IIC
ITU	INTUG
SPF Telecom	PTC

Another classification by type of activity shows:

.Resource Allocation: policy, standards, finance, facilities: ABU,ITU POSTEL

. Technical Assistance: planning, training, expert consultation: AIBD, APT, ITU, SPF.

.Information Source: publications, database, seminars: ABU, AIC, AMIC, APT, PTC, TTT.

.Communication Network: member contacts: AIC, AMIC, ICCC, PTC.

While these classifications on the basis of membership and activity are imprecise, they do serve to show that non-governmental organizations focus on information sharing activities while the intergovernmental organizations having official standing are more involved in resource allocation.

Through meetings and information exchange, the regional membership organizations appear to perform a needed function in the development of telecommunications in the region. Over time, they help to prepare for new alliances and for a new consensus surrounding telecommunications development and utilization.

3. CONFIGURING FORA PACIFIC

In 1983, the Pacific Telecommunications Council developed and published a first listing of non-profit membership organizations focused on the Pacific with an interest in communications. This publication was updated and reissued in 1986. Recently, the 1990 edition was published; it contains about 80 entries.

As a natural outgrowth of this interest in what other organizations are doing, PTC called an ad hoc meeting of the heads of such organizations who were thought likely to be represented this past May, 1990, at the CommunicAsia conference in Singapore. Fourteen individuals representing twelve organizations participated. Temporarily, PTC serves as the informal facilitator of information exchange among these entities. Tentatively called FORA (Federation of Regional Associations) Pacific, this paper is one part of an ongoing attempt to configure FORA Pacific to meet the emerging needs in this region.

Four general goals were distilled from the Singapore meeting and subsequent discussions:

.maintain a master list of scheduled meetings;

.maintain a comprehensive list of publications;

.enhance services to current members; and

.develop new exchange mechanisms as needed.

These goals only suggest that the regional organizations should do a bit more, a litle more systematically, than they now do. As such, the goals hardly merit a new organization with a new acronym.

However, the Singapore scenario for FORA Pacific was to configure not only a new but also a new type of network resident inter-organization. As currently envisoned, FORA will make extensive use of phone, FAX, email, file transfers and teleconferencing in meeting its goals. Perhaps, each participating organization will in time become a logical address and a gateway through which its own members can directly access FORA; but FORA itself will not have a physical headquarters as the member regional associations each do. Thus, FORA represents an attempt to use in imaginative and productive ways the technologies of central interest to the affiliate organizations.

A first master list of scheduled meetings was developed after the Singapore meeting. Such a list has a a number of uses, most obvious, some not. For example, if AMIC in Singapore were to invite a resource person from the EC in Brussels to address one of its meetings, APT in Bangkok might wish to invite that same person to stop in Bangkok to make a presentation on the way home. In a few years, a master list would reduce the chance of having two meetings being scheduled by different organizations in nearby cities on similar topics on the same days, as sometimes now happens. Further, a member from Sydney attending the annual PTC conference in Honolulu might be able stop in Tokyo on the way home to sit in on a meeting of one of the Asian ISDN working group meetings. And, so on.

All of the regional organizations who have expressed an interest in FORA annually publish a wide range of materials. These materials include but are not limited to conference working papers, quarterly periodicals, research reports and books. This paper-based information can be regularly cataloged and a comprehensive list of these publications can, with a continuing effort, be maintained. But the need for more rapid access than traditional paper publication and postal service provide has led several FORA organizations to develop online information bases for use by their members, notably, AMIC and APT. Possibly, through the offices of FORA, these important resources could be made more widely available, and online.

Both the master list of scheduled meetings and the comprehensive list of publications could be used to enhance the services that the FORA organizations routinely provide their own members. Specifically, a schedule of meetings should often enable a member of any FORA affiliated organization to attend two important meetings for little more than the price of one. A comprehensive list of publications would help assure that current members of the FORA affiliated organizations do not overlook critically important information.

FORA Pacific, as it is now taking shape, can facilitate exchange among the affiliate organizations, as well as the ordinary members of each of those organizations. Further, the increasing capacity of telecom networks in the Pacific, the emerging standards for message handling and directory services, can help move FORA a giant step into the future. It is not the purpose of this brief paper to detail the alternate futures of FORA; rather it is the purpose here to report the line of thinking that has followed from the Singapore meeting, and to invite additional contributions to it. Just maybe, FORA Pacific is an idea whose time has come!

PACIFIC RIM ISDN APPLICATIONS TODAY !
CALIFORNIA <——> JAPAN

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1.0 ABSTRACT

The evolution of ISDN (Integrated Digital Services Network) services within and between countries in the Pacific Rim has been slower than anticipated to date for many reasons. California's recent movement toward a leadership position in provisioning public network ISDN services which meet multinational business application requirements will have a significant positive impact for California, Japan and other countries deploying ISDN networks. However, the continued cooperation of ISDN industry participants is necessary to insure the successful deployment and cost saving use of ISDN applications and technology.

2.0 ISDN BARRIER DOMAINS

It is now generally agreed by many participants in the telecommunications industry that the ISDN revolution is unfolding at a less rapid pace than earlier envisioned. While the cost saving and productivity benefits of ISDN technology are visible to the technologically sophisticated early adopters and others knowledgeable in the telecommunications field, these benefits are often lost when viewed from a traditional price/value analysis by potential end customers.

Why is this a problem? Essentially, implementation of ISDN services into the mainstream of everyday life is a paradigm change in communications technology not unlike the introduction of past revolutionary technologies such as: cars, radio, TV and yes, even the telephone itself. The major difference with ISDN is that it was created and directed to serving business customers, and that the general public benefits and access to this new technology are not as readily apparent as were radio, TV and the first telephones. In fact it seems as though the strength of its integration capabilities need to be brought into clearer focus for the general public.

Today, business people are faced with many alternative telecommunication choices, some of which are perceived to be easier to understand, to implement or seemingly less expensive. As such, ISDN deployment and use has encountered several general barrier domains to its general public acceptance:

- **Technical**
- **Regulatory**
- **Financial**
- **Educational**

Having recognized these factors, many efforts are now underway by service providers, regulators and vendors to address these barriers. However, the real challenge and perhaps the best chance for success is to bring the benefits of ISDN to the public at large. This can only be done through widespread industry cooperation.

2.1 Technical Domain

In a somewhat simplified form, present ISDN technology can be broken into three general elements as depicted in figure 1: **switching nodes**, **network interconnection**, and **customer terminals**. Each of these elements is directly impacted by two major technological domains: **negotiated standards** and **equipment availability**.

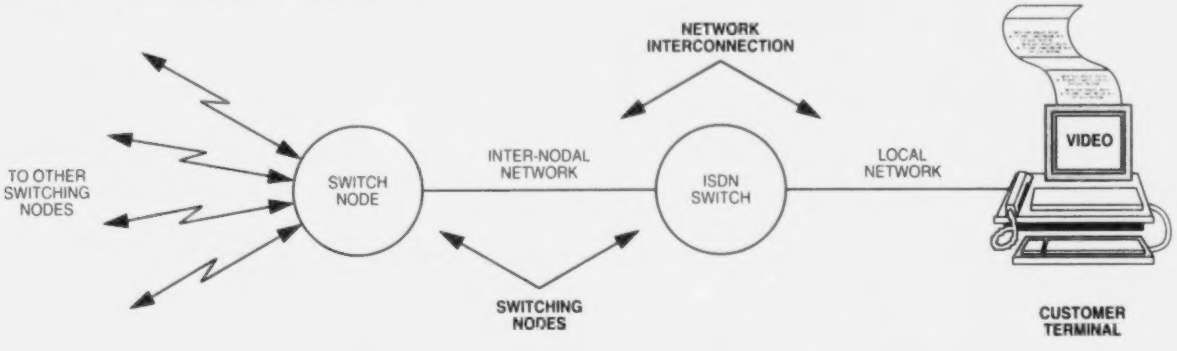

Figure 1
ISDN Technology Elements

The goals of various standards bodies such as CCITT, Bellcore, and the vision of ISDN, is to provide specifically defined standards for service delivery in terms that will best serve the public and clarify issues for service providers and vendors to follow. However, this has turned out to be somewhat of a "chicken and egg" scenario. While standards bodies are finalizing standards definitions, technological advances continue to be made which are often implemented ahead of set standards. In free market economies this is quite often the case since vendors and service providers must do this to meet customer needs or risk the loss of business. Consequently, the ubiquitous technological and cost saving benefits that standards bring to customers are sometimes out of step with the market place needs and increasingly rapid technological advances. This situation is even made more complex by sometimes having to cope with multiple standards such as CCITT 30 channel and North American 24 channel transmission standards. This suggests that a paradigm shift must occur in bringing together linkages between the standards bodies, service providers, manufacturers and customers.

This situation has undoubtedly contributed toward customer confusion surrounding ISDN and the true cost/benefit relationship with the ISDN telecommunication solution. While customers are looking for total system solutions to their needs, they have been, until very recently, only offered pieces.

The first pieces to be implemented were the switching nodes and even these initially came in differing "standard" flavors. Thus, the initial applications were intra-switch or so called "ISDN islands" and usually required vendor specific customer premise or terminal equipment. However, service providers soon discovered that customers saw little benefit from a technology that would only allow them to talk to themselves, they had branch offices and other customers elsewhere throughout their region and the world. The interconnection of these islands via SS7 signaling or alternatively other Switched Digital Services networks has become a new priority. Cooperation among many industry participants during the past year has created and successfully demonstrated ISDN applications such as dial-up video and low cost group IV fax, even on an international basis.

Now that these switched networks are becoming a reality and customers are positively responding, the next technical ISDN barrier element is coming to the forefront; the lack of widely available and affordable customer terminal equipment. While somewhat sophisticated ISDN applications can be easily cost justified by end customers (video, fax, bulk data transfer), wide scale integration of ISDN solutions will not occur until the cost of basic ISDN CPE is priced closer to existing analog CPE costs without stripping away highly touted features that differentiate ISDN from other look alike solutions. Industry personnel will also have to ultimately reach a concensus as to the value customers will gladly pay for ISDN benefits, is it 1.1, 1.3 or 1.5 times the cost of seemingly alternative equipment and services. Is ISDN Centrex worth twice as much as a standard Centrex service? ISDN CPE equipment will also require some level of adaptation until full interoperability takes place. Availability of low cost, interoperable ISDN CPE is now critical to improving the cost/benefit ratio to end customers. A recent article in *Communications Week*, evaluated various ISDN sets available in the United States. It gave an "A" feature rating for most sets but rated none higher than a "C+" when considering overall price/performance. (1) Another analysis by *Network World* reached a similar conclusion by stating "most users won't pay five or six times the price for a feature phone set simply because it is connected to an ISDN service." (2) Clearly the challenge is to provide affordable ISDN terminal equipment.

2.2 Regulatory Domain

Dynamic change may be the only constant in the regulatory arena. While less than 10 years ago, public telecommunications infrastructures were under some form of central jurisdiction, control of telecommunications networks now range from centrally controlled in countries like Taiwan and Korea, to the semi de-regulated competition in the U.S. This climate easily creates regulatory, tariff, and service differences similar the technological barriers, but they can have far greater impact due to their legal implications.

United States Federal Judge Green's divestiture decree of the U.S. Bell Telephone System has not only forever altered public telecommunications in the U.S., but has influenced divestiture and privatization of foreign PTT's world wide. Some recent examples would be divestiture activities in Australia and Japan and the privatization of New Zealands public telephone network. In the U.S., competition is now spreading from the inter-exchange carrier market to the local-exchange markets. Local competition, which is often less constrained by regulatory concerns, is now creating alternative local loop choices to the LEC's (local exchange carriers) for business customers in large metropolitan areas.

Deployment and customer acceptance of new services like ISDN are often inter-twined with local and regional regulatory tariff structures. Regulatory concerns impact everything from product pricing to feature offerings and network equipment depreciation schedules. Regulatory issues can be a real impediment to the realization of ubiquitous ISDN services between service providers. A customer in country A may not be able to use a tariffed feature in his country when calling country B because it may not be offered in country B's tariff. One example might be the eventual effect of recent U.S. court rulings on personal privacy could inhibit services which require ICLID (incoming calling line identification) feature information. Other regulatory barrier domains include "rate of return" versus "price caps" on earnings and differing plant depreciation schedules. Such differences impact the financial incentives for industry investment in newer ISDN technology, thus helping to create different levels of service and contribute as another destabilizing force in trying to build services between countries.

2.3 Financial Domain

The investment in network modernization that must be made for ISDN service technology is significant. As such, this investment in ISDN technology is relatively hi-risk, particularly if there is no clear view of what the future technology will look like, and when that technology will realistically become available. Therefore, it is very important that the large and necessary investment being made today can evolve to higher order applications, including broad band, while preserving today's capital investment. This is true for service providers, manufacturers and end customers.

The ISDN business investment decision is highly complex and has a corresponding ripple effect throughout the industry. As in any business decision, a positive return must be realized and the challenge is to accelerate this return to fuel continued investment. This can vary depending on whether the industry participant is long or short term focused. Oftentimes U.S. industry is cited for being short term focused as compared to most of its counterparts in the Pacific Rim. Nevertheless, the decision factors are similar and include:

- Corporate image and vision
- Assessment of market needs
- Anticipated new revenue potential
- Impact on corporate human resources
- Cost saving benefits
- Regulatory environment
- Equipment price, quality and availability

The priorities assigned to and evaluation of these factors is unique to each ISDN industry participant in each country. This is a business reality despite the cross cultural and multinational intent of world ISDN standards committees. One such difference facing service providers are the differing depreciation schedules for various countries. Some examples are shown in figure 2. (3)

These differences have a serious impact on the investment decision. An otherwise positive investment decision can be completely offset by equipment depreciation schedules that may be out of date or unrealistically out of step with rapidly advancing technologies of today. This can be even more complicated in the U.S. in those states where multiple sets of depreciation schedules must be followed for federal and state tax purposes as well as regulatory purposes (often the longest).

All in all, typically those countries making significant investments in their telecommunications infrastructures today, have more favorable equipment depreciation allowances than those countries that do not. One can easily see why a multinational concern may not choose a public network ISDN solution when a private network solution

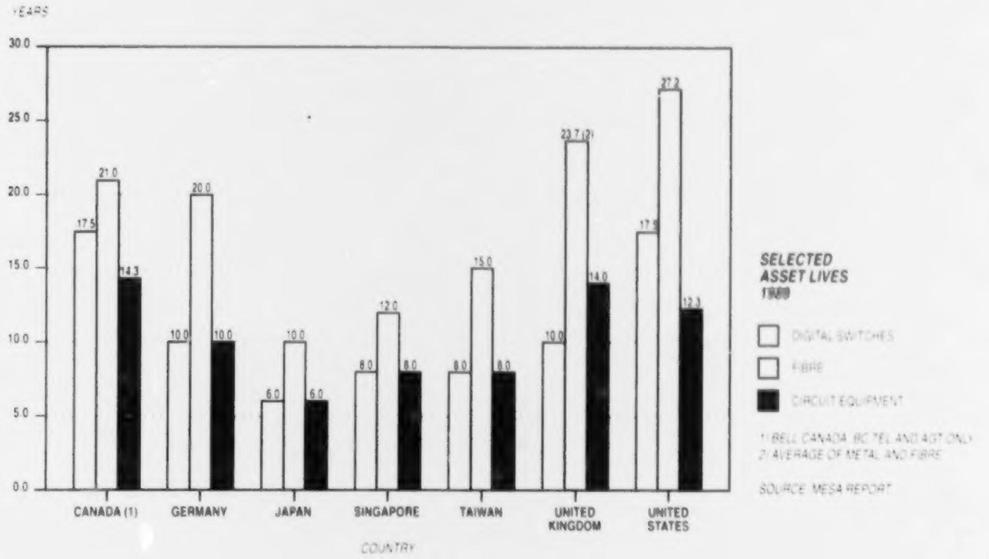

Fig. 2
Sluggish depreciation schedules hinder new technologies

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avoids many regulatory traps. In some instances this has led to various risk sharing arrangements between vendors and service providers in order to meet customer needs which also address the regulatory concerns for keeping the rate payers whole.

Additionally, for the service provider making the pro-ISDN investment decision, it is very important to recognize and acknowledge that similar investments in organization and structure must be made. ISDN is the first of the future technologies that definitely cuts across the traditional voice and data organizational structures of service providers. One of the important factors in this investment is the human resource investment. Addressing these factors up front gives organizations an opportunity to collapse and realocate the traditional organizational structures and staff plus train them to provide integrated services.

Finally, it is very important for service providers to create the proper financial incentives for a firms sales force to gain maximum coverage. If they are not properly trained and backed with the proper incentives toward offering customers ISDN solutions where applicable versus dedicated ones, a flawlessly executed investment strategy may be significantly slowed or halted right at the prospective customers front line. This will further drive up investment costs and increase the payback period. Oftentimes the risks of new technology introduction can be minimized by sharing the risks between service providers, applications people and equipment vendors.

2.4 Educational Domain

In order to fully capitalize on the capabilities of ISDN applications, paradigm changes in how the general public views and evaluates its telecommunication needs is becoming more apparent. This includes internal training as well as customer training. It is important for people within the organization to think differently, to think and understand integrated solutions versus multiple traditional solutions to accomplish similar applications. While the initial learning curve for integrated solutions may appear to be steep, ISDN solutions are usually more cost effective and there is typically an explosion of application ideas by customers once they understand and taste the success of their first application. For example, the August 1990 announcement by McDonald's corporation to adopt ISDN as the platform for its future world wide telecommunications needs, based upon its initial application testing with Ameritech, is significant. McDonald's clearly envisions the benefits a world wide CCITT standard ISDN platform will bring to its own business environment.

Successful development and knowledge transfer of the whole notion of the price/value proposition to customers is needed to maximize business acceptance and insure success. While many of the early adopters of ISDN technology were often technically savvy, most customers are not and look to their vendors and service providers for advice. As such, ISDN training is crucial for all employees throughout the organization. This includes a knowledgeable field sales force, integrated operations and maintenance personnel and the important headquarters based support organizations which help provide a consistent backbone to the service. Oftentimes, by products of internal training can be used in various forms for educating customers: brochures, advertisements, news articles and public demonstrations. All in all, ISDN education is essential and pays long term dividends.

3.0 BARRIER BUSTER CONCEPTS

As can be clearly seen, the introduction of a new and revolutionary ISDN technology has difficulties, but despite the barriers, significant progress has been made. This seems to be especially true during the past year when one scans the countless press appearing in all forms of media concerning ISDN technology and its applications. As one views this progress there is an underlying commonality between the recent progress - **industry cooperation**.

Due to this industry wide cooperation that has included service providers, vendors and most importantly - **customers**, the benefits of ISDN applications technology have been displayed in countless demonstrations worldwide. As in past technological revolutionary changes, cooperative frameworks amongst and between participating industry members is a critical factor. What are some of these cooperative frameworks and how do they apply to ISDN?

- **Public demonstrations** - Interactive public demonstration of ISDN applications is an educational hit. Creative video and multimedia applications geared to real life situations have an instant, obvious and long term impact on those who see and actually participate in them. The impact factor can be significantly multiplied when a distant location is connected through a dial-up switched 56/64Kbs digital services network, and don't forget the media. Such demonstrations clearly require the cooperative efforts of vendors, service providers and even customers. This also provides a chance for industry participants to work out bugs they may later encounter in providing actual customer services.

- **New customer applications** - Customers are often quite willing to try new technologies that might prove useful to them, especially if it can increase productivity, make life easier, and give them strategic advantages over their competition. Most customers are looking for applications, so while ISDN may be the technology that makes things possible, we believe the application has to be the focus for achieving customer interest and not the ISDN technology itself. An application may include many ISDN features (video, data, voice, etc.) combined into a package or equipment offering targeted to a specific audience. In the U.S., ISDN multimedia real estate shopping might be one example. Since ISDN is a relatively complex technology ("What do you mean when I can talk, see live video and transfer computer data all at the same time on my two telephone wires?") it is still the ISDN cross-industries responsibility at this time to create and demonstrate useful ISDN service applications to the general market.

- **Feedback evaluation** - Once customers are on board, it is important to keep in touch with the customer and the other industry participants that make the customers application possible. Service providers and vendors must pro-actively seek feedback from all sources whether good or bad. This can help to work out the kinks in your processes sooner and lead to greater customer satisfaction which feeds increased customer opportunities. All industry participants share in the risks and in the rewards.

- **Technical and regulatory agreements** - These are probably the two key areas in realizing ubiquitous publicly accessed ISDN services. While there may be significant differences in both these areas for the near future it is still important to communicate these to other vendors, service providers, regulatory bodies and customers. CCITT standards have been a great help in the technical arena but who addresses the scale of similar issues on the regulatory side? Informal partnerships between industry participants may be the best method to address these concerns at the moment. How do you provide services of a like kind that give customers maximum flexibility? Just think where ISDN might be today if all countries in the Pacific Rim agreed to similarly tariff the same set of ISDN features, extendibility of services, and the service providers could depreciate their plant and equipment purchases over 5 or 10 years!

- **Safeguards** - Mutual cooperation implies a high degree of trust between industry participants. How do you mutually cooperate in joint account management arrangements of whatever form? Here, safeguards play an important role. Industry participants must ask how they will safeguard the self interest of and between players and end customers where the success of future technologies may well depend upon industry wide mutual cooperation.

- **Continued cooperation** - All of the above are not just one time efforts. They are elements of a continuous process that requires constant review. Also there is no one general overall perfect solution that fits all customers. Some general overall concepts might be developed that work for your organization, but the specific ones selected to be used will depend upon each customer since the industry participants will change for each customer. Each new customer application seems to open new doors and application opportunities in which familiar industry participants will continue to participate and new ones will enter.

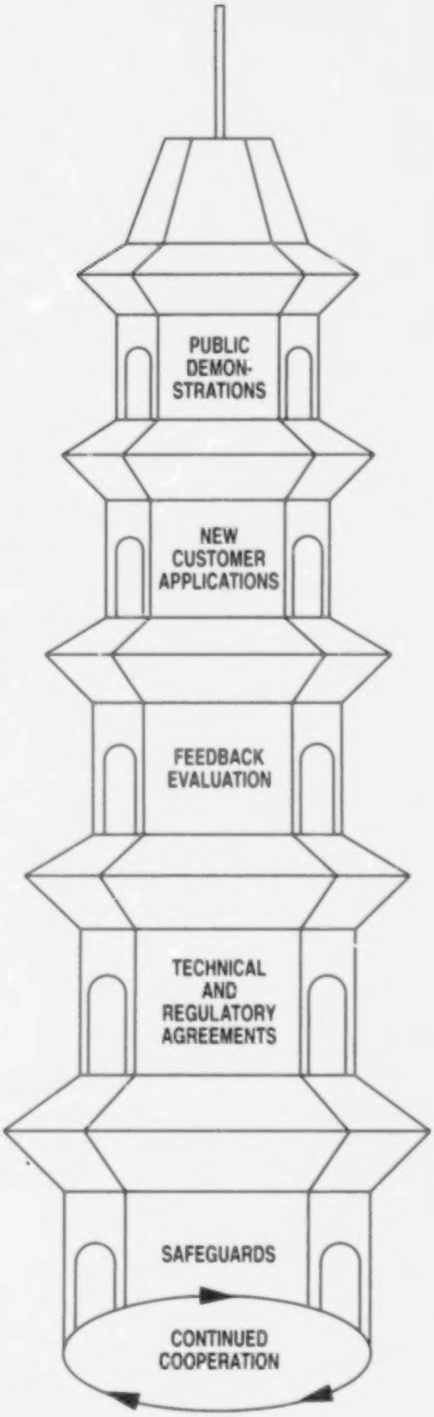


Figure 3
Cooperative Frameworks

4.0 PATTERN FOR OUR SUCCESS

Beginning in late 1990, ISDN customers located in California and Japan were able to communicate with each other through the public switched network.(4,5) How was this possible? **Mutual cooperation**, made possible through the long term partnership efforts of AT&T, Pacific Bell, KDD (Kokusai Denshin Denwa) and NTT (Nippon Telegraph and Telephone). Elements of our successes include:

- Partnership arrangements
- Extendibility of services
- Mutual joint account management and safeguards
- Like services
    - a. video conferencing
    - b. data network gateways
    - c. multimedia
    - d. bulk file transfers

By making practical application and use of elements within the cooperative framework model and working with available off the shelf products and services, multiple industry participants were able to configure standard customer service platforms allowing end customers to utilize various ISDN applications on a dial-up, pay as you go basis within California and to Japan. Customers in both countries (some claim California is it's own country!) are now looking forward to expansion of their ISDN applications to other ISDN ready countries and locations within the U.S.

Initially, the differences between ISDN service offerings and availability of those services between California and Japan seemed monumental. For example, even though ISDN service offerings were considerably further ahead in Japan than in California (for various reasons related to the barrier domains), the extendibility of services was the major complaint from all customers and so it was one of the first concerns to be addressed.

Acknowledging that ubiquitous SS7 would be many years down the road it was decided to interconnect ISDN "islands" through use of the AT&T and KDD SW56/64Kbs switched digital services networks readily available throughout the U.S., Japan and to many other countries in the world. Significant network and equipment testing was conducted during February, 1990, leading to three days of live customer video conferencing demonstrations between Pacific Bell's Los Angeles location and NTT's Tokyo location. (6,7,8) An outline of this basic network setup is shown in figure 4. New customers have built additional services based upon the key elements of the basic network concept (figure 5).

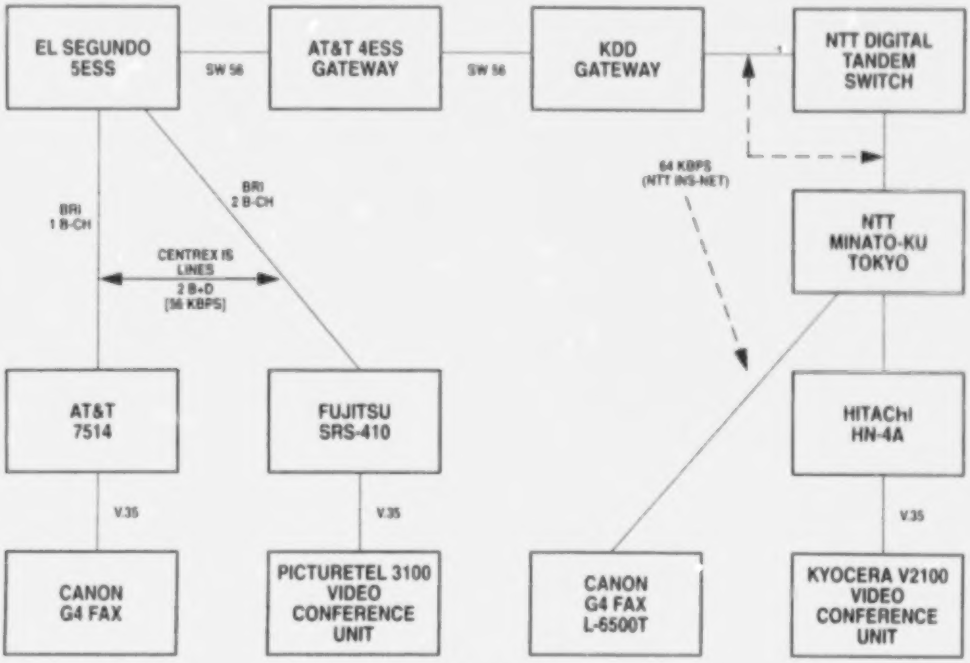
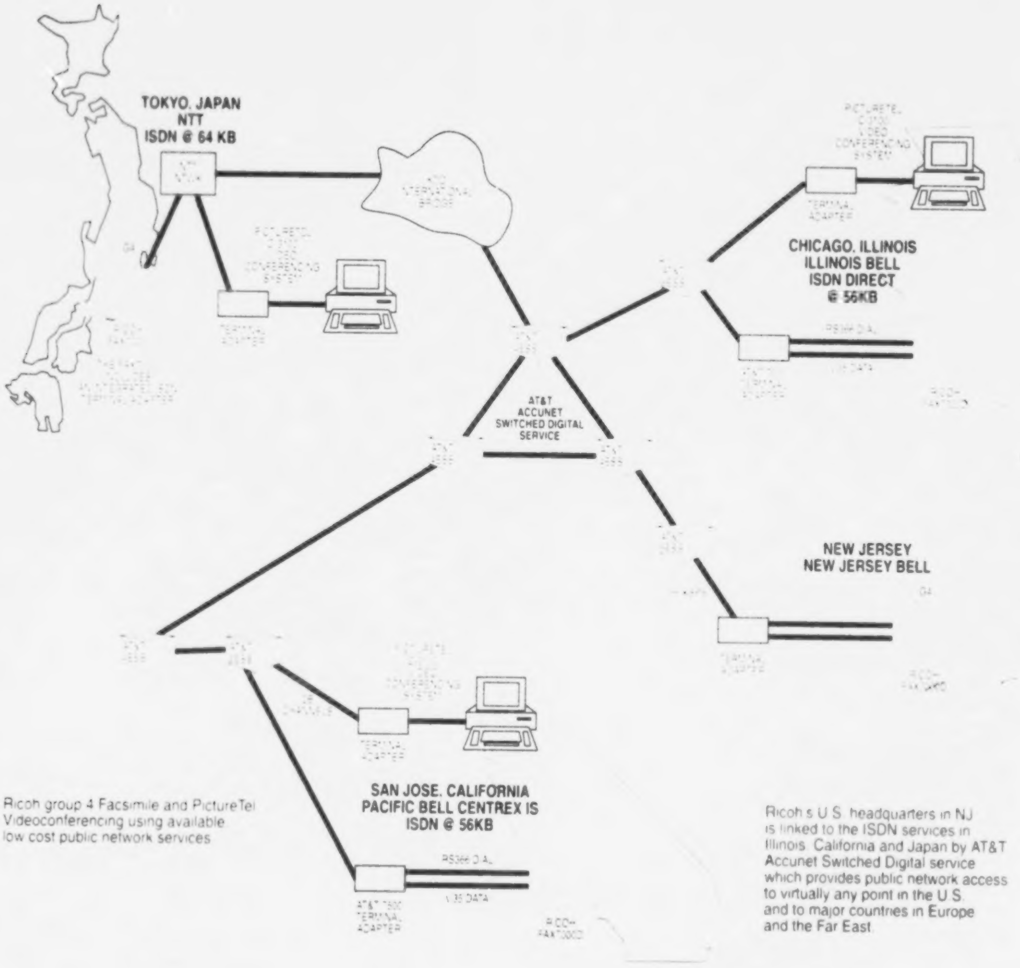

EL SEGUNDO 5ESS
SW 56
AT&T 4ESS GATEWAY
SW 56
KDD GATEWAY
NTT DIGITAL TANDEM SWITCH
BRI 1 B-CH
BRI 2 B-CH
CENTREX IS LINES
2 B+D
[56 KBPS]
64 KBPS
(NTT INS-NET)
NTT MINATO-KU TOKYO
AT&T 7514
FUJITSU SRS-410
HITACHI HN-4A
V.35
V.35
V.35
CANON G4 FAX
PICTURETEL 3100 VIDEO CONFERENCE UNIT
CANON G4 FAX L-6500T
KYOCERA V2100 VIDEO CONFERENCE UNIT

Figure 4
Pacific Bell/AT&T/KDD/NTT
ISDN Video Conference
March 1990

This first success sparked considerable customer interest in California and was soon followed by other demonstrations. One was the first dial-up 336kbs distant learning video demonstration between California and Australia. (9) Another was Pacific Bell's participation as a distant end point in ISDN demonstrations at NTT's Collections 90 show held in Tokyo, October, 1990.

Simultaneous to these activities were many others addressing local network deployment, inter-operability, compatible CPE and feature sets, as well as regulatory and pricing concerns. A significant amount of work was accomplished by all parties concerned that customers appreciate. There were many roadblocks and non-believers to be confronted along the way, but customer interest is now changing that. We are now looking forward to positively addressing customer CPE concerns utilizing the same cooperative frameworks that helped us to bridge ISDN island connectivity interests.


TOKYO, JAPAN
NTT
ISDN @ 64 KB
G4
TERMINAL ADAPTER
PICTURETEL VIDEO CONFERENCING SYSTEM
TERMINAL ADAPTER
CHICAGO, ILLINOIS
ILLINOIS BELL
ISDN DIRECT
@ 56KB
RS366 DIAL
AT&T ACCUNET SWITCHED DIGITAL SERVICE
NEW JERSEY
NEW JERSEY BELL
G4
TERMINAL ADAPTER
TERMINAL ADAPTER
SAN JOSE, CALIFORNIA
PACIFIC BELL CENTREX IS
ISDN @ 56KB
RS366 DIAL
V.35 DATA
AT&T 7500 TERMINAL ADAPTER

Ricoh group 4 Facsimile and PictureTel Videoconferencing using available low cost public network services

Ricoh's U.S. headquarters in NJ is linked to the ISDN services in Illinois, California and Japan by AT&T Accunet Switched Digital service which provides public network access to virtually any point in the U.S. and to major countries in Europe and the Far East.

Figure 5
Actual customer ISDN network configuration

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5.0 NEXT STEPS ?

While these cooperative frameworks have been key to the recent ISDN successes in California and Japan, is this the right direction? It seems so in this case and possibly in others as the number of customer inquiries focused on our successes continue to increase even from locations beyond California and Japan. Implementing low cost tariffed public network ISDN service solutions will eventually greatly benefit all public interests. Initially though, Pacific Rim based multinational business concerns may be the first to envision and adopt the benefits of this technology. Continued industry cooperation may however hold the key to extensive deployment of ISDN throughout the Pacific Rim. What is needed is considerable collaboration in the following vital areas:

- Technical
- Regulatory
- Applications development
- Increased public access
- Decreased entry costs
- Increased public awareness of ISDN benefits

As this cooperative framework continues to be adopted by customers and others in industry, the real issue is not ISDN, but our working together as an industry to bring about the proliforation of this and future technologies.

REFERENCES

1. Robert Lefkowits, "Looking at ISDN Telephones," *Communications Week*, June 4, 1990, pp S2-S15.

2. Edwin Mier, "ISDN CPE availability lags behind expectations," *Network World*, Nov. 19, 1990, pp 38-55.

3. Alan Stewart, "RBOCs' bleak forecast for US telecoms," *Communications International*, Sept. 1990, pp 23-26.

4. Dawn Bushaus, "ISDN Goes Global, Three use PacBell international access," *Communications Week*, Sept. 3, 1990, p.6.

5. Richard Karpinski, "ISDN links help users span globe," *Telephony*, Sept. 3, 1990, pp. 9-10.

6. "International Demo," *Communications Week*, March 26, 1990, p. 50.

7. "Dealing Across the Pacific," *Los Angeles Times*, March 12, 1990, p. D3.

8. Bob Larribeau, "TO HAVE when you have not," *TE&M*, June 15, 1990, pp. 50-52.

9. Richard Karpinski, "Pac Bell, AT&T head down under for ISDN video," *Telephony*, July 30, 1990, p. 22.

An Enhanced Facsimile Communication System for A Global Network

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1. ABSTRACT

Facsimile communication is expected to become one of the major telecommunication services in Japan. A public facsimile comunication system called the Facsimile Intelligent Communication System(FICS) has been in commercial use by NTT since 1981. In order to increase the demand for FICS services and satisfy user requirements, the FICS must be more convenient and more reliable.

In 1990, an enhanced facsimile communication system called the Intelligent Facsimile Storage and Conversion equipment(I-STOC) was put into operation. It was developed to flexibly cope with the demands of the more complicated functions of FICS.

This paper describes the FICS outline and design concepts of the I-STOC.

2. INTRODUCTION

The public facsimile comunication system called the Facsimile Intelligent Communication System(FICS) has been in commercial use by NTT since 1981. Since then, the second and third version have been developed and put into operation to economically expand the service area throughout the country and to enable various communications services, such as computer-facsimile communication services and multi-address delivery services. The number of FICS subscribers has been rapidly increasing, and was more than 380,000 as of May 1990. It is expected to become one of the major telecommunication services in Japan.

In 1990, an enhanced facsimile communication system called the Intelligent Facsimile Storage and Conversion equipment(I-STOC) was put into operation. It was developed to flexibly cope with the demands of the more complicated functions of FICS. I-STOC is connected to the Facsimile Storage and Conversion equipment(STOC) which is one of the FICS communications processing nodes.

I-STOC consists of functionally distributed units for service control, media conversion control, protocol control, data storage control and system control. Each unit is connected by an optical fiber loop. This configuration makes it easy to add new services and makes it possible to achieve the most economical system for both low and heavy traffic.

International communication services and multi media communication services can be achieved by using this configuration.

This cofiguration constitutes a universal type for communication processing systems.

This paper describes the FICS outline and design concepts of the I-STOC.

3. FICS OUTLINE

3.1 Network Configuration

The basic configuration of the Facsimile Intelligent Communication System(FICS) is shown in Fig. 1. The FICS consists of the public switched telephone network, communication processing equipment and the digital transmission lines that connect them.

Connecting the telephone network and communication processing equipment is controled by the Toll switch for the communication processing gateway switch(TGS) which has the customer files and charging function.

The communication processing equipment consists of the Facsimile storage and conversion equipment(STOC), and the Facsimile data conversion and interface control equipment(FDIC).

STOC has been set up in a hierarchical stage in order to achieve communication processing functions, such as storage and conversion. This equipment can easily provide long-term storage services.

The FDIC has been developed to allow more convenient utilization of facsimile communication. This equipment provides media conversion functions such as, conversion between facsimile signals and coded data and protocol conversion.

3.2 Service outline

An outline of the existing service is shown in Table 1. Almost all basic functions can be used in multi-address calling and computer facsimile communication.

3.2.1 Basic function

(1) Basic calling

Basic calling is a typical end-to-end facsimile communication when a document has a single destination. This service permits economical long distance delivery.

(2) Notifications

If the FICS receives a facsimile message and can not send it to a designated subscriber because the line is busy, a non-delivery notification is returned to the orginator's terminal with 1/3 of the original message.

When the FICS can send a facsimile message to a designated subscriber, a delivery confirmation is returned to the originator's terminal in compliance with a request. This is optional and a toll service.

3.2.2 Multi-address calling

(1) Multi-address calling

The multi-address calling service can deliver a facsimile message to 100 different destinations at one time.

This service permits business information distribution from a main office to branch offices and shops over the entire country.

(2) Night delivery multi-address calling

This service makes it possible to deliver a message to a maximum of 1000 different destinations at night when there is very low traffic. A user can send a message to the FICS for this service during the daytime.

3.2.3 Computer and facsimile communication

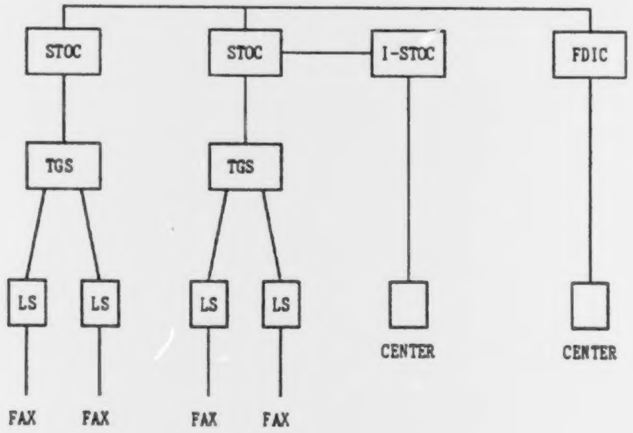
(1) Information retrieval service

A facsimile signal containing marksheet information is converted to mark information or coded data, and delivered to a designated center. A usual facsimile picture signal can also be delivered to the center.

This service is used to retrieve insurance contracts from branch offices in the insurance business, and access property data by real estate agents.

(2) Information distribution service

A sequence of charactor codes, coming from an information center, is converted to a



LS: Local Switch.
TGS: Toll Switch for communication processing gateway function.
STOC: Facsimile storage and conversion equipment.
FDIC: Facsimile data conversion and interface control equipment.
I-STOC: Intelligent facsimile storage and conversion equipment.

Fig. 1 FICS System configuration(1990)

Table 1. Service Functions

Items	Service Functions
Basic Function	·Basic Calling ·Ringing, Automatic Calling ·No-ringing, Automatic Calling ·Automatic Re-calling ·A5/A4/B4 document size conversion ·Facsimile Mail Box ·Abbreviated Dialing Number ·Delivery to Non-contract User ·Close User Group Connection ·Non-delivery Notification ·Delivery Confirmation ·Confidential Delivery
Muti-Address Calling	·Muti-Address Calling ·Nigth Delivery Multi-Address Calling with charge discount
Computer and Facsimile Communication	·End to Center Communication with mark sheet patten recognition ·Center to End Communication with code patten conversion ·Hard written Numerical Character Recognition

facsimile signal and deliverd to a designated facsimile receiver. The information coming from the center can also contain image patterns. This service is used for collecting and distributing real-time information such as real estate information.

4. I-STOC OUTLINE

4.1 Enhance the FICS

In order to increase demand for FICS services and satisfy user requirements, the FICS must be more convenient and more reliable.

In 1990, an enhanced facsimile communication system called the Intelligent Facsimile Storage and Conversion equipment(I-STOC) was put into operation. It was developed to flexibly cope with the demands of the more complicated functions of the FICS. I-STOC is connected to the Facsimile Storage and Conversion equipment(STOC) which is one of the FICS communications processing nodes(Fig. 1).

4.2 I-STOC configuration

The I-STOC configuration is shown in Fig. 2. I-STOC consists of functionally distributed units for service control, media conversion control, protocol control, data storage control and system control. Each unit called an Intelligent Function Unit(IFU), is

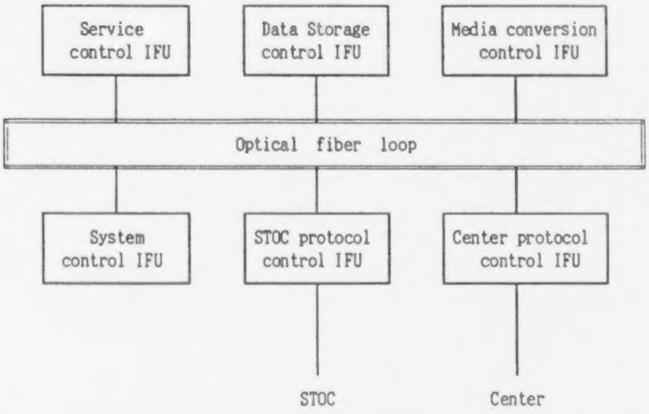


Fig. 2 I-STOC configuration

connected by an optical fiber loop. The aim of this cofiguration is as follows:

(1)This configuration makes it easy to add new services.

(2)This configuration makes it possible to achieve the most economical system for both low and heavy traffic. It is possible to install IFUs in the I-STOC properly, according to the traffic.

The existing system configuration is a tightly coupled type using a single processor.
The tightly coupled system must grasp all functions of the communications processing system and the control program must be changed each time a new function is added or some functions are modified for new services. This means that adding a new service affects existing services. A sufficient debugging period is required to append and modify new services.

4.3 Processing outline

It is possible to remove the influence on IFUs without affecting added IFUs by the following 2 methords; (1)generating call management information at the IFU which receives documents from outside the system and (2)by transferring the information from the processing IFU to the next IFU.

The processing outline of this system is shown in Fig. 3.

(1) When receiving documents from outside the system, the A-IFU(service control IFU) generates the call management information and transfers it to the next IFU(B-IFU). The call management information consists of scheduling information and each IFU's processing information, such as code to pattern conversion, pattern recognition and data storage management. The call management information structure is shown in Fig. 3.

(2) When receiving call management information, the B-IFU is put into operation and transfers the documents to the next IFU(C-IFU), according to the call management information.
Similarly, the C-IFU is put into operation and transfers the documents to the next IFU(D-IFU).
Finally, the D-IFU sends the documents to other system.

On the assumption that new service is realized by appending a new IFU(E-IFU) to the I-STOC, the processing outline for the new service is shown in Fig. 4.

(1) When receiving documents from outside the system, the A-IFU generates new call management information that is different from the call management information shown in Fig. 3.

Table 2. I-STOC functions

Equipment	Function
System control IFU	·Equipment management ·Traffic management ·Congestion control ·Diagnosis processing ·Maintenance processing ·Charge management
Service control IFU	·Service analysis ·Call management information generating
Media conversion control IFU	·Code to patten conversion ·Patten recognition
Data storage control IFU	·Data storage management
Protocol control IFU	·STOC interface, Center interface, Common signal interface control

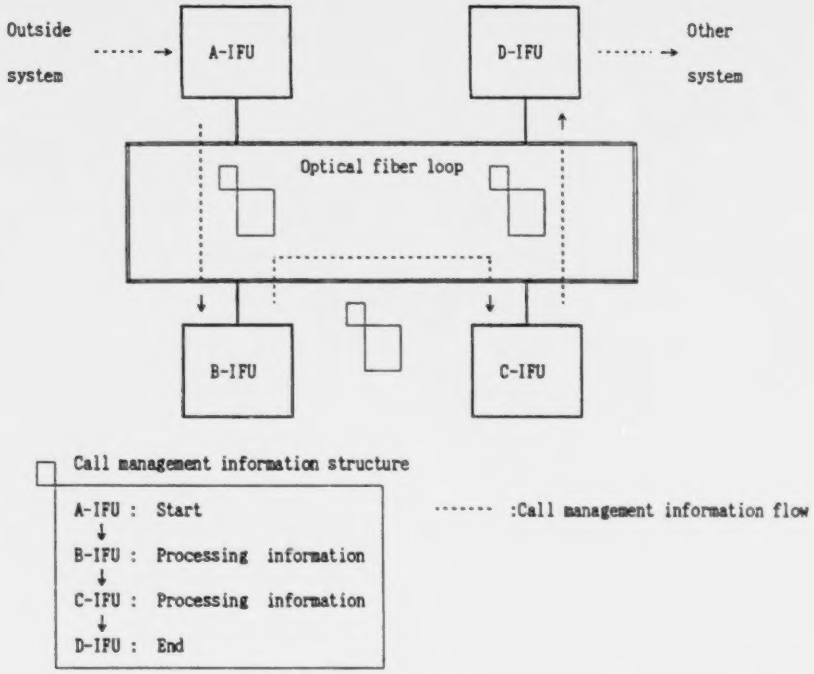

Outside system
A-IFU
D-IFU
Other system
Optical fiber loop
B-IFU
C-IFU
Call management information structure
A-IFU : Start
B-IFU : Processing information
C-IFU : Processing information
D-IFU : End
:Call management information flow

Fig. 3 Processing outline

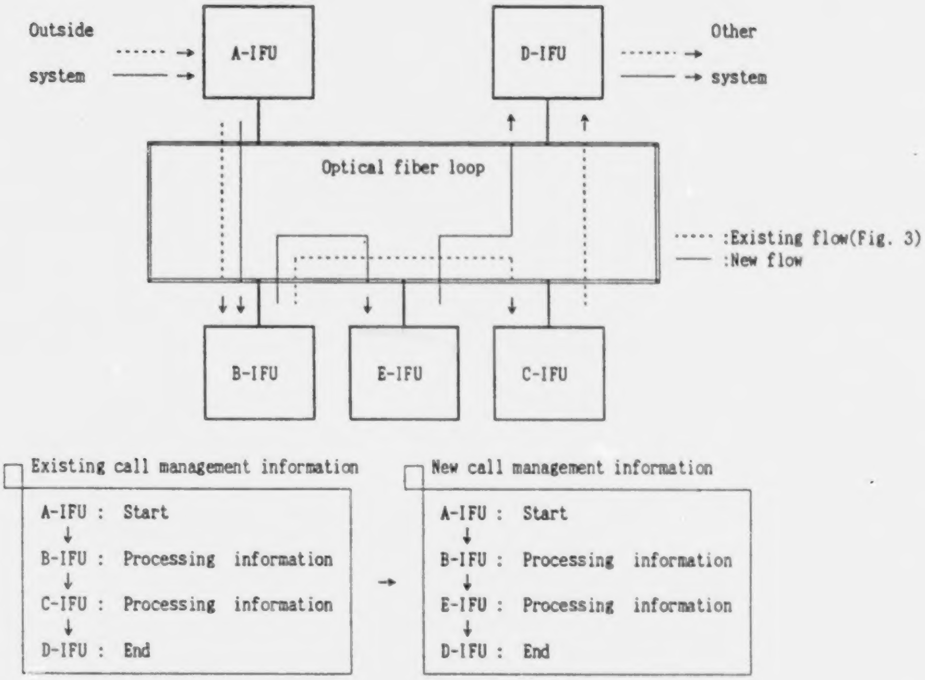

Outside system
A-IFU
D-IFU
Other system
Optical fiber loop
:Existing flow(Fig. 3)
:New flow
B-IFU
E-IFU
C-IFU
Existing call management information
A-IFU : Start
B-IFU : Processing information
C-IFU : Processing information
D-IFU : End
New call management information
A-IFU : Start
B-IFU : Processing information
E-IFU : Processing information
D-IFU : End

Fig. 4 Processing outline of new service

(2) Each IFU is put into operation and transfers the documents to the next IFU or outside system, according to new call management information. Only documents receiving IFU should be modified and other IFUs should remain unchanged to accept new services. A debugging period for this system is considered shorter than that of the existing system.

4.4 Application for a global network

International communication services and multi media communication services for a global facsimile communication network can be achieved by using the I-STOC configuration.

Figure 5 is an example of multi media communication services, such as facsimile-videotex communication service, using the I-STOC configuration. The development of I-STOC should be considered as follows:

(1) Two new IFUs are appended to the I-STOC. One is a Videotex protocol control IFU, the other is a Videotex signal- Facsimile signal conversion IFU.

(2) The service IFU should be modified to generate new call management information for new services. Other exsisting IFUs should not have to be changed to accept this service.

5. CONCLUSION

The I-STOC configuration makes it easy to add new services and makes it possible to achieve the most economical system for both low and heavy traffic.

This cofiguration constitutes a universal type for communication processing systems.

NTT will prompte development of the FICS, in order to offer more versatile services and make the network more convenient, using the I-STOC cofiguration.

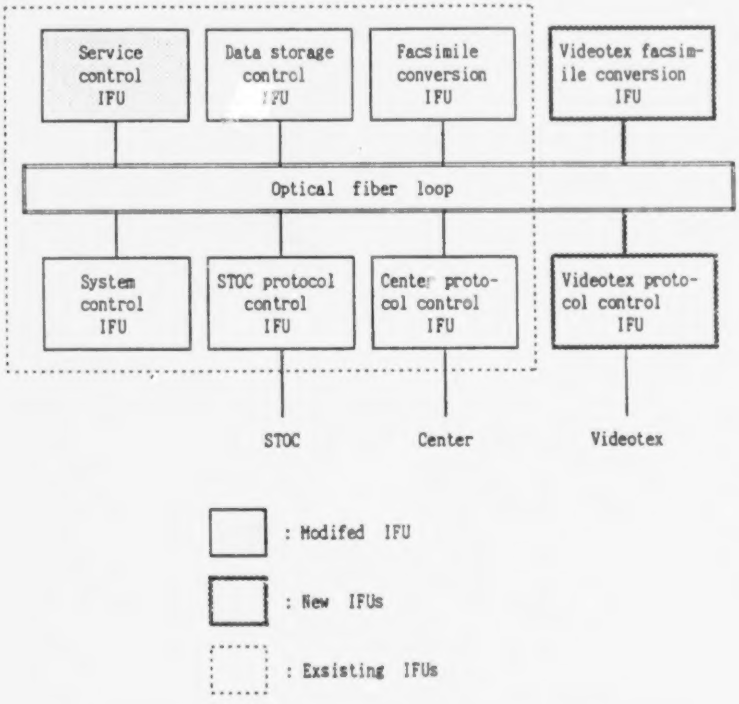

Service control IFU
Data storage control IFU
Facsimile conversion IFU
Videotex facsimile conversion IFU
Optical fiber loop
System control IFU
STOC protocol control IFU
Center protocol control IFU
Videotex protocol control IFU
STOC
Center
Videotex
: Modifed IFU
: New IFUs
: Exsisting IFUs

Fig. 5 I-STOC configuration for facsimile-videotex communication service

A PASSIVE OPTIC SOLUTION FOR AN URBAN REHABILITATION TOPOLOGY

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1. ABSTRACT

This paper will describe an effort that was undertaken to address the feasibility of providing fiber optic facilities to replace existing copper plant; thus enhancing a planned rehabilitation program in the NYNEX corporation. It will focus on the use of passive optic solutions, although other architectures were also studied. Real geographical areas, typical problems encountered and vendor/telco solutions to these problems will be discussed. Conclusions reached and recommendations made are stated at the end of this study.

Introduction

The New York and New England Telephone Companies were faced with the task of rehabilitating outside plant facilities in various areas in the NYNEX region such as Brooklyn, Queens, Bronx, Charlestown and Newport. Many areas scheduled for rehabilitation were old neighborhoods with row houses and backyard pole lines which, in many cases, were inaccessible without entrance to the customer's house.

Rehabilitating the existing copper plant entirely with new copper facilities was considered. It was decided that copper facilities, to the extent feasible, be replaced with fiber optic systems. Penetrating the loop with fiber optics today will reduce future maintenance problems associated with aging copper plant and position the loop for future broadband services.

Some of the constraints and problems associated with providing outside plant relief to these types of urban areas are:

1. Unavailability of space for Controlled Environmental Vaults (CEVs), huts or outside cabinets.

2. Limited chance to obtain the right of way (ROW) for any of the above noted items.

3. Limited access to existing outside plant facilities.

4. Rear yard plant, located along common property lines became encumbered with tree growth, fences, storage sheds, clothes lines, etc.

It became immediately evident that these urban areas did not resemble those areas previously selected for Fiber in the Loop (FITL) trials. Most of the FITL trials in this country extended fiber beyond the remote terminal (RT) units into the distribution plant in suburban or rural areas and were part of new buried plant developments. Much experience was gained in these textbook like cases, but, in urban areas of large towns and cities, a completely different set of design criteria had to be addressed prior to deploying fiber optics in the urban loop.

To evolve to an all fiber loop, not only new developments have to be fiberized, but the embedded copper facilities must also be replaced and removed. Figure 1 illustrates a possible plan for affecting this task.

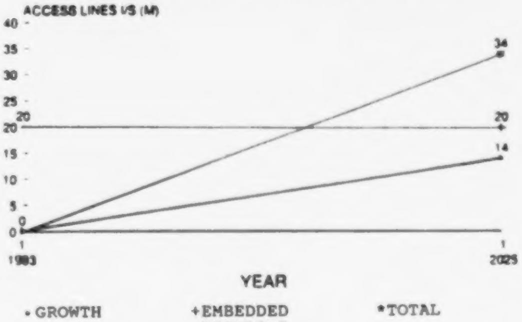


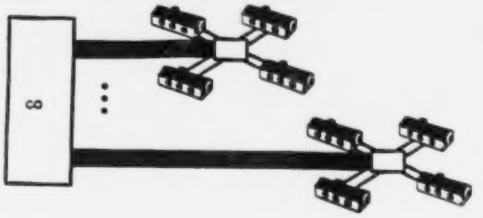
FIGURE 1

Architecture

To minimize rehabilitating aging copper facilities with copper replacements, it was decided to assess available and emerging fiber optic architectures and systems to arrive at the best solution and fit, utilizing fiber optics, if possible, for this environment. In order to achieve NYNEX'S fiber access strategy, the sharing of resources and cost and service parity with copper based solutions, were strong considerations.

The Star, Multi-Star (double, triple) and Bus architectures were reviewed.

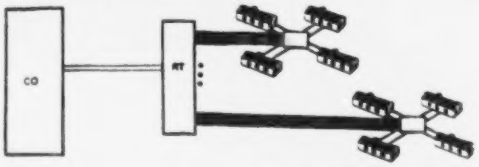
Star Architecture



STAR

The Star architecture is a viable solution for the urban area. Fiber optic cables would be installed from the central office to the block(s), placed on existing aerial facilities and then connected to Optical Network Units (ONUs) located on poles, in or on buildings.

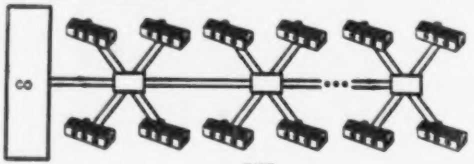
Double Star Architecture



DOUBLE STAR

The active Double Star architecture which has been successfully trialed by various Regional Bell Operating Companies (RBOCs) was assessed and rejected for the urban areas previously described (e.g., closed block, limited or no ROW). Inability to obtain ROW and lack of space for CEVs, huts, etc., was a primary reason for rejection of an architecture that utilized a large, field deployed remote terminal. In addition, powering a fiber optic double star system is more complicated than powering single star or passive systems.

Bus Architecture



BUS

The Bus architecture has a good fit with many situations encountered in the urban area. Rear lot line construction in densely populated blocks appeared to efficiently utilize the bus architecture. One or two blocks could fully utilize a single bus configuration without the need for running across and around streets.

In addition to the shorter term focus of penetrating the loop with fiber optics in areas scheduled for rehabilitation, this study considered the longer term strategy of migration to an all fiber loop.

System Design/Analysis

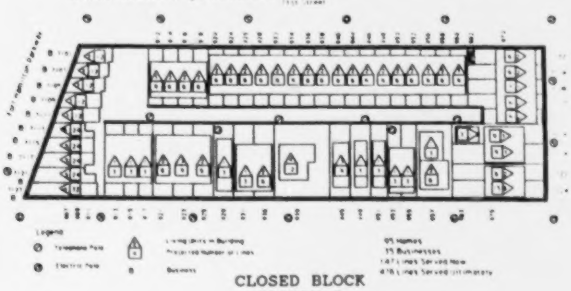
A survey of available and emerging fiber optic systems was completed to determine applicability to the constraints of the urban areas previously noted. It was previously stated that those architectures with the need for large RTs would be virtually impossible to deploy in many urban areas.

Both passive optical networks with their ability to negate the need for field deployed RTs and single star configurations (systems with field located RT functionality pulled back and located in the telephone company central offices) of what is normally considered active double star architectures became attractive topologies for this project.

Vendors that were known to have systems generally compatible with NYNEXs requirements were invited to meet with the NYNEX urban rehabilitation project team. Project definition and the urban environment was detailed by NYNEX and, when requested, walking tours of urban areas to inspect field conditions were conducted. It was noted that the vendor community involved with this project was surprised and enlightened by this experience.

The densely populated, closed block scenarios generated new design criteria for FITL components, especially in the packaging of outside plant terminals. Vendors responded with proposals that altered their original designs to meet these criteria.

To help NYNEX assess the capability of proposals for the urban area project, each participating vendor was given a scaled layout of a typical block located in Brooklyn (see Figure 2). The layout illustrated housing units, pairs required, lot lines and existing telephone plant. It was requested that the vendors draw their solution on this layout. Due to the nature of this block, no field located terminal was possible. In addition, a brief FITL questionnaire, technical in nature, was distributed to each vendor for completion. The questionnaire was used as an aid in the evaluation process.



CLOSED BLOCK
FIGURE 2

Discussions and work sessions between NYNEX and the vendors were conducted to ensure understanding of and conformance to NYNEX's requirements. Particular interest was given to the following items:

1. Transmission Medium
2. Fibers Per ONU Required
3. Channels Per Fiber Delivered
4. Loopback Capability at the ONU
5. ONU Design - Capacity in lines, physical dimensions, types (aerial, buried, building)
6. Loop Limit from RT
7. TSI/TSA Functionality
8. Powering Options
9. OSS Interface
10. Availability Date
11. System Documentation
12. Training Availability
13. Estimated Costs

Several of the above noted items are worthy of discussion:

Channels per Fiber(s) - a single star architecture without the field located RT, loses the pair gain advantage of double star, DLC based architectures. To minimize this shortcoming, which is manifested by the need for additional fibers between the central office and the ONU, a system that maximizes the number of channels delivered over the transmission facility is desirable. This consideration should be fully analyzed to optimize the OSP design and minimize costs.

ONU Design - in the urban areas surveyed, it was noted that, in many instances, requirements for as many as 25 lines per OSP terminal was encountered. This was due to houses originally built and occupied as single family residences being converted to 2 and 3 family dwellings. With the narrow lot widths in the block, it is entirely possible to serve as many as eight units from a single pole (or terminal). This suggested ONUs with capacities greater than those previously planned by vendors.

The physical size of an ONU designed to be pole mounted is critical. Climbing and working around large enclosures, while suspended from a body belt, is a consideration. Access to the contents of the ONU was discussed. Dual access, one access for copper drop wire terminations and one for opto-electronics was discussed - this protects opto-electronics from the craft and the elements during drop wire installation and maintenance.

ONU types were also discussed. In urban areas, there are clearly applications for pole and building mounted designs. The concept of modular design to allow for horizontal stacking of, perhaps, 25 line units, was discussed. This concept will find application in multi-family apartment buildings.

Powering - the powering issue is common to all fiber optic systems and all vendors experience the same problems with cost effectively powering the fiber optic loop. A single superior powering solution, if found, could be applied by any or all vendors of FITL systems. Basically, FITL systems will be powered by network (line) powering, local powering, or some combination thereof.

For the urban area, it was decided that several different options be considered for powering the fiber loop. Each route should be evaluated and a powering option selected based on criteria applicable to that route. For example, network powering could be deployed on short loops where it is possible to deliver enough power from the C.O. to the ONU over existing copper facilities. For longer loops, where electrical losses become excessive, it may be possible to increase voltages to -130V to reduce losses, and again, use existing copper facilities. Or, perhaps a small Remote Power Supply (RPS) unit could be deployed in the field to provide the power requirements for a block(s) or sub-distribution area.

As a final example, when utilizing a telephone entrance room for a large entity such as an apartment or commercial building, local power, provided by the customer remains a viable option.

System Selection

Evaluation of systems proposed by the vendors involved in the NYNEX urban rehabilitation effort resulted in the following conclusions:

Passive optical networks exhibit the best fit to many urban areas found in the NYNEX region for the following reasons:

o They eliminate the need for a field deployed remote electronics terminal and this also results in less electronics in the outside plant.

o Emerging passive optical netwok systems investigated have the ability to deliver services to large numbers of subscribers (presently up to 384 on one fiber).

o The use of passive optic splitters introduces a degree of freedom and economies in designing the fiber optic distribution loop, especially for the urban block neighborhood.

o The powering problem is less complex than those associated with field deployed RTs housing DLC based systems.

Figure 3 represents an interesting solution to the sample block. This should not be construed as an endorsement of this system and is included herein for purposes of illustrating a passive optical solution for the NYNEX urban topology.

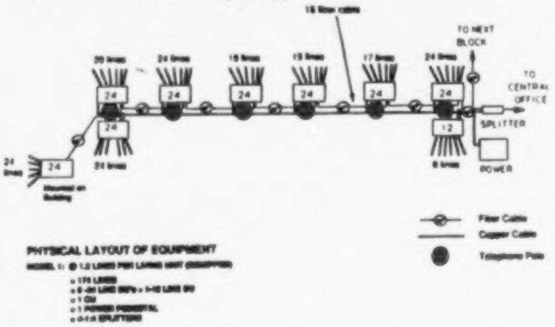


FIGURE 3

Conclusions

The urban rehabilitation study group concluded their work and made a recommendation for review that NYNEX conduct field trials in urban areas to gain experience in the design, construction and maintenance of PON's. It was recommended that these trials be conducted in areas where expenditures for rehabilitation of the existing copper plant are planned and where churn and service order activity are high enough to ensure thorough exercising of the system.

The experience gained during these field trials will be incorporated in the possible future general deployment of FITL in the NYNEX region.

Acknowledgements

The author would like to thank A. Andersen, R. Anderson and E. McDonough of the NYNEX Corp. for their advice and contributions to this project.

ISDN in an Intelligent Building of a Regional City

Total ISDN in The Anabuki Intelligent Tower

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ABSTRACT

This paper explains an example of an approach that was made to high-grade network construction in Takamatsu, by using the ISDN as an infrastructure, to shorten the distance gap from Tokyo.

1. INTRODUCTION

Anabuki Construction Inc., whose main office is in Takamatsu, Kagawa, on Shikoku, constructs apartment houses. Their activities include site procurement, planning and designing the buildings, and the service and maintenance work. In October 1989, Anabuki Construction Inc. completed its new head office building, called the Anabuki Intelligent Tower, which has the most advanced office automation(OA), building automation (BA), and communication (COM) equipment. Eleven-stories tall, the Tower has been constructed based on the concept of a "high-grade intelligent building with creative amenity space that will remain fresh even in the twenty-first century". For the infrastructure of the information communication system that is the core of an intelligent building, Anabuki Construction Inc. has adopted the INS Net 1500 (PRI:Primary Rate Interface) that Nippon Telegraph and Telephone Corporation (NTT) just started to use.

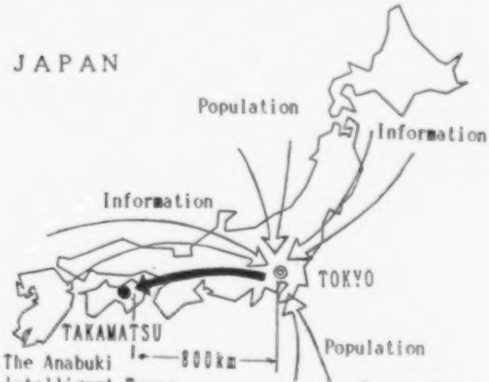


Figure 1

2. APPLICATION OF ISDN

In Japan today, the population and information tend to be concentrated in the Tokyo metropolis. This is partly caused by a conspicuous increase in the number of local companies that have moved their headquarters to Tokyo. Such movements are said to result from the fear of information time lag or cost differences between the metropolis and regional cities.

Anabuki Construction Inc. wanted to keep their main office local. To avoid the distance gaps in the information transfer from Tokyo, they needed a high-grade information communication system. It was highly important for them to obtain all information as fast as in Tokyo to process it, and at the same cost of information communication in Tokyo.

From the viewpoint of speedy information transfer and low communication costs, we determined the ISDN to be the optimum means of minimizing the distance gap. Advantage was also expected from the ISDN for its characteristics of being on the public networks and the availability of highly valuable additional services.

3. OUTLINE OF THE SYSTEM

In the new head-office building of Anabuki Construction Inc., the INS Net 1500 has been adopted for the first time in Western Japan, with the INS Net 64 now in use in its 28 domestic branch offices connected to the main office.

The new head office building is equipped with the most advanced digital electronic exchange, ISS (Information Switching System). This core system is connected to a host computer, workstation, telephone sets, and G4 facsimile machines. Communication is through the INS Net with branches, at which workstation, telephone sets, and G3 facsimile machines are installed.

Figure 2 illustrates the Anabuki Total ISDN system.

4. FURTHER COST REDUCTION

4.1 Integration of multi-media

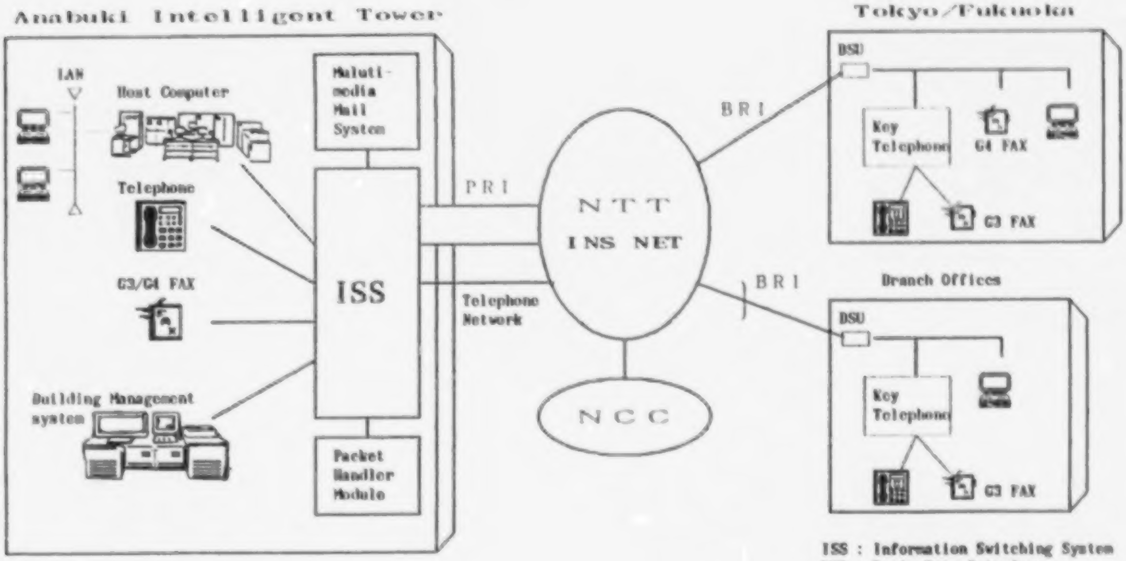
At the main office building, the newly adopted exchange ISS with its abundant interfaces is connected to all information devices in the building (host computer, G4 facsimile machines, telephone sets). A large cost reduction has been achieved by integrating all multi media into one INS Net 1500 line.

The following table compares the differences in basic monthly rates (the new network communication fee remains the same as the conventional rate).

Apart from the inegration into one INS Net 1500 line, eight analog telephone lines are also provided as backup lines to improve the reliability. These backup lines assure the external communication even if the INS Net 1500 fails, thus eliminating the fear which corporate activities.

Table 1 Comparison of Cost (unit: Yen/month)

	Telephone network + DDX-P	ISDN
Speech 35 lines (backup:12!)	Telephone network ¥2,350x35= ¥82,250	INS NET 1500 ¥45,000 for 1 line Backup ¥2,350 x 12 = ¥28,200 Packet fee (2channels) ¥1,000 x 2 = ¥2,000 Packet multiplication (2 channels) ¥300 x 2 = ¥ 600
FAX 10 lines	Telephone network ¥2,350x10= ¥23,500	
DATA 9.6kbps x 2	DDX-P ¥30,000x2= ¥60,000	
Total	¥165,750	¥75,800 (Difference:¥89,950)


Anabuki Intelligent Tower
LAN
Host Computer
Telephone
G3/G4 FAX
Building Management system
Maluti-media Mail System
ISS
Packet Handler Module
PRI
Telephone Network
NTT
INS NET
NCC
BRI
BRI
Tokyo/Fukuoka
DSU
Key Telephone
G4 FAX
G3 FAX
Branch Offices
DSU
Key Telephone
G3 FAX

ISS : Information Switching System
BRI : Basic Rate Interface
PRI : Primary Rate Interface
DSU : Digital Service Unit
NCC : New Common Carrier

Figure 2 Anabuki Total ISDN System

4.2 Implementation of Least Cost Routing (LCR) to correspond to the ISDN

In Japan, there are three inner new carriers, NCC (New Common Carrier) except NTT. Each company has its own complicated tariff system based on the time zone and distance segment. This inhibits the user from easily selecting a line supplier at the lowest rate when making a toll call. In conventional exchanges, Least Cost Routing (LCR) is now provided for the public telephone networks.
The route with the lowest call rate is automatically selected and connected when a toll call is made. Now FUJITSU Ltd. developed the new application of LCR for ISS corresponding to the ISDN. So It reduces the communication costs.

4.3 Two-step transmission of facsimile

G4 facsimile machines have been introduced at the remote bases to increase the transmission speed up to 64K bps between Takamatsu and Tokyo, and between Takamatsu and Fukuoka, again reducing the communication cost.
Further, with the branch offices around Tokyo and Fukuoka, efficient and economical communication has been implemented by high speed transmission through the G4 and telephone network, taking advantage of the relay function of the G4 facsimile machine. For example, sending one A-4 size document through the G4, enables about a 60% cost reduction.

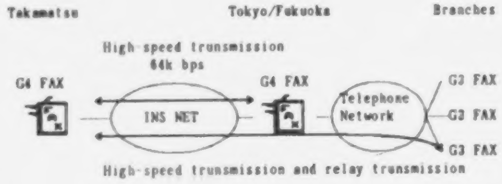


Figure 3 Two-step transmission of facsimile

5. GRADED-UP INFORMATION SYSTEM

5.1 Improved facility by subaddresses

An important point of the speech system is the combined use of subaddresses and dial-in service. All calls from non-subscribers to ISDN, such as business correspondents, are connected directly to the extensions. For in house calls, all branches have subscribed to the INS Net to enable extension calls directly from the ISDN network on a toll dial, using the subaddresses that the ISS has assigned to the extension numbers.

This has implemented an unattended exchange operation with improved efficiency at the main office, by saving three operators.

5.2 Control of lighting and air conditioning by ISS

Linking integrated building control system with the ISS whose main purpose is information communication has improved the office environment. The air-conditioning and lighting are controlled from a central area. For work done before or after reguler work hours and on holidays, the air-conditioning and lighting are partially controlled over telephone lines on the desk.

5.3 Unattended message receiving by mail system

A multi-media mail system improves the efficiency of in-house and external communications.
For example, an alternate receiving service provided by voice mail enables message to be received even if the receiving person is absent or using another line, and to assure the message will be passed to the receiver later.

This eliminates the unnecessary time loss for retrying the call because of a busy line, and assures the communication transfer.

6. EVALUTION

(1) Cost reduction effect
- A Monthly reduction of ¥89,950 for the basic rate only
- Manpower reduction of three persons by unattended operation

(2) Improved operate-ability
- Direct call of extension enabled by adoption of subaddresses and dial-in services
- High-speed transmission through G4 facsimile machines

(3) Equipment configuration that readily corresponds to future expansion
- For Anabuki Construction Inc., further expansion of the bases and increases in the information amount are expected. Adoption of B-ISDN is also planned for the future. To prepare for such possibilities, the new ISS can be upgraded in the field to construct a flexible network.

By combining the ISDN with the ISS, a medium-scale company such as Anabuki Construction Inc. can construct a highly efficient information communication system without much initial cost.

Thus, we can say that the ISDN is the most suitable network for Anabuki Construction Inc., that has its headquaters in a suburban city.

7. FUTURE TASK

The information communication system is intended for voice, data, and facsimile. To further defeat the distance gaps, still video and motion image information is necessary. The BRI(Basic Rate Interface) size of 64k bps is insufficient handle such wide-band information. To satisfy this need, application of a B-ISDN is necessary. Details of the B-ISDN are being examined by C.C.I.T.T.. The present system is scheduled for upgrading in the future to meet the trend of technical progress.

(1) Data communication with still video image (64k bps) --Electronic catalog
(2) Commnication upgrading by video conference system and electronic mail
(3) Remote CAD system to enable separation of the design department
(4) Upgrading of communication in the field required for apartment construction

IN CONCLUSION

For implementation of the intelligence function at the new head-office building of Anabuki Construction Inc., introduction of the INS Net demonstrates a great effect. The network is configurred through maulti-media line (INS Net 1500 for the head office and INS Net 64 for branches) by integrating the data system, speech system, and facsimile system. Compared with conventional systems, the new system has shown great advantages in respect to (1) communication cost, (2) communication speed, (3) extended service, and (4) extension possibilities for the future.

Of course, to determine whether the use of the INS Net is most effective, an examination is necessary by comparing the amount of data transfer and traffic. For Anabuki Construction Inc. the optimum conditions have been fully satisfied by the system scale.

This example proves that the ISDN network enables a nationwide operation even through a distant suburban head office system. This indicates one solution to the currently debated problem in Japan of the excessive concentration of information processing in Tokyo.

The Role of Information in the Regional Development of Japan

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1. ABSTRACT

The concept of an Information Activity (IA) Index is useful in order to categorise the nature of the content of information by a quantitative method. Analysis of IA in the 43 sub-regional centers in Japan and comparison between the results for 1965 and 1985 provide some useful insights concerning the economic impact of information in the context of regional development.

2. INTRODUCTION

The purpose of this study is to examine how information affects the economic development of sub-regional centers in Japan.

Information has a peculiar character in the context of computer network and telecommunications. Information means, in engineering terms, signal in either digital or analog form. Information in this sense is neutral from any meaning of its content. In discussing the social and economic implications of information, however, the word implies a message, or meaning. Information as the message exist only in relation to its users. Even if the same information is transmitted through the same electronic media, such as a telephone or computer network, the information does not convey any meaning to those who do not need or understand it. For those who need it, on the contrary, information is useful and means much.

One of the features of this study is its focus on information as the message, or the content of information, in analysing the effects of information on economic activities. Though arguments about the so called "Information Society" are well rehearsed, most of them tended to focus on media or the means to transmit and to distribute information, such as videotex, fibre optic cable, digital switches, to name a few. The realisation that these media alone do not automatically generate economic development is, however, becoming common knowledge based on the experiences of the past ten years. Information is useful only when it is put into practice. The recognition that the medium is not the message, but merely a means of delivering the message, is the basis of analysis in the paper.

The concept of information adopted in this paper, however, does not necessarily deny the impact of innovation in information technology. We are now at an appropriate moment to consider the most efficient way to design and plan an information infrastructure - such as a regional PC network or CATV system - in a way which serves regional economic development. Thanks to innovation, storage, processing and use of information in an electronic form become much easier to users. This study rather puts forward the necessity of taking into account what is transmitted through, and what is input to such an infrastructure and who generates information.

We adopt the concept of an Information Activity index (IA) to quantify the substance of information by means of a statistical method. The IA was originally developed by the Economic Planning Agency (EPA) in Japan in 1985. Detailed explanation about the IA index is provided in a following section.

The second feature of this paper is a focus on forty-three sub-regional centers which are located outside of the three main Metropolitan areas in Japan. Those cities satisfy one of the following conditions;

a. Cities where prefectural capital is located and with population less than 1 million.
b. Cities with population of more than 300,000 but less than 1 million.

The names and populations of these cities are listed in Appendix.

These cities enjoyed a dominant position in the local region in political, commercial and educational terms in the past as centers of fairly small regions. They are now faced with a critical situation in that they could be placed under the strong influence of economic activities in Tokyo, or that they could be left behind by economic development. The situation as such is now being accelerated by transport improvements, such as highways and super express trains. Though several enhanced communications networks are being built, such as the videotex system or a regional CATV in many of these cities, most of the incoming flow of information originates in Tokyo. Much of the outgoing flow is addressed to Tokyo, too. In short, the economic take-off in the course of adjustment to the "Information Society" is in a critical phase for those cities. They could

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Acknowledgements
1. The views expressed in this paper are those of the authors and do not necessarily reflect those of OECD, its Member countries or Shinshu University.
2. This paper is developed on the basis of a previous version which will shortly be published.

succeed to take-off or surrender their functions as economic centers to Tokyo. Hence they are considered to be appropriate cases to examine how the content of information affects urban economic activities.

The third feature of this study is a comparison of data between the two years, 1965 and 1985. They coincide with the years when the National Censuses were carried out. These years are chosen as representatives of two economic eras in Japan. Japan experienced rapid industrial development between the late 1950s and the late 1970s. After the second "Oil shock" at the end of the 1970s, the Japanese economy began to shift its focus from mass production (i.e. manufacturer-oriented) to the satisfaction of individual customers' needs (i.e. consumer oriented). Service industries developed simultaneously with the diversification of consumer needs. There is little doubt that the 1980s is a starting point for a new type of society, i.e. an information society, where information is coming to have increasing impact on production and innovation processes. Hence comparison between these two years will indicate how the relationship between information and the economy has changed over time.

While this study focuses on Japanese sub-regional centres, the methodology adopted here has universal applicability. The same methodology could be used in analysing regional development issues in other countries, provided similar data is available. The interaction between information and economic activities, or the problems of small cities with the disadvantage of geographical distance from the national economic center, can be discussed in the same context.

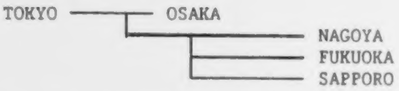
The structure of the paper is as follows: an outline of the Japanese urban system is discussed in the second section in order to help readers who are not familiar with Japanese urban studies. In the third section, a method to quantifying different kinds of information, i.e. the Information Activity index (IA), is discussed. The relationship between various kinds of information and urban economic development is analysed in the fourth section. Correlation coefficients are calculated to assess the relationship between the two. The findings of this study are discussed as a conclusion in the fifth section.

3. JAPANESE URBAN SYSTEM

The term "urban system" might sound unfamiliar to most of the readers who are not specialists in urban studies. This term expresses mutual relationships between cities linked together in a social/economic network. A single city cannot exist by itself. Cities exist in national or international relationships with each other. Hence cities in one nation or in the world can be said to be components of a system, interacting with each other by means of a flow of people, goods, money and information. In this system, each city has its own role to play, which aggregates to a whole system.

One of the characteristics of the Japanese urban system in terms of the creation, supply and demand of information is the dominance of Tokyo in these activities to the rest of the cities in Japan. Figures 1 and 2 exhibit the amount of information, in terms of words supplied and consumed, in all the prefectures in Japan.

These two Figures enables us to identify five regional centres in Japan in terms of the supply of and demand for information. They are Tokyo, which is the national centre as well, Osaka, Nagoya, Fukuoka and Sapporo. These cities forms an urban system as is conceptually indicated below:



The relationship between the 43 sub-regional centers and Tokyo in the urban system in Japan can be conceptualized as a series of sub-regional centres, having the five main regions between the national centre, i.e. Tokyo, and the sub-regional centres. In short, from the perspective of information flow in Japan, the urban system is headed by Tokyo, followed by the four cities as the regional centers of origin and destination of information. Each of these five regional centers (including Tokyo) has sub-regional 'centers in its own region.

There is a considerable information gap between Tokyo and the other cities in Japan,in terms of volume. If there is a strong relationship betwen information and economic activities, the data exhibited in Figures 1 and 2 indicates that appropriate policy might be taken to overcome regional disparities in information flows.

4. INFORMATION ACTIVITY INDEX

4.1 DEFINITION OF AN INFORMATION ACTIVITY INDEX

The concept of an Information Activity Index (IA) was originally developed by the Economic Planning Agency (EPA) in Japan in 1985. The Agency developed IA during the process to find methodologies to quantify information in order to provide an analysis to measure the impact of information on the national economy.

The EPA defined IA as follows;

> Information Activities include the following activities; decision making and planning; creation and production of information; collection, storage and supply of information; processing of information; education and training; transmission and provision of information (1).

Based on the definition above, the EPA created two kinds of IA's using different statistical data. One kind of IA is created on the basis of the census on industries and another on the census on occupations. Tables 1 and 2 correspondingly exhibit industries and occupations classified according to the six categories of IA defined above.

Figure 1 SUPPLY OF INFORMATION, BY PREFECTURE; 1975 AND 1985.
Source: Ministry of Posts and telecommunications, 1987

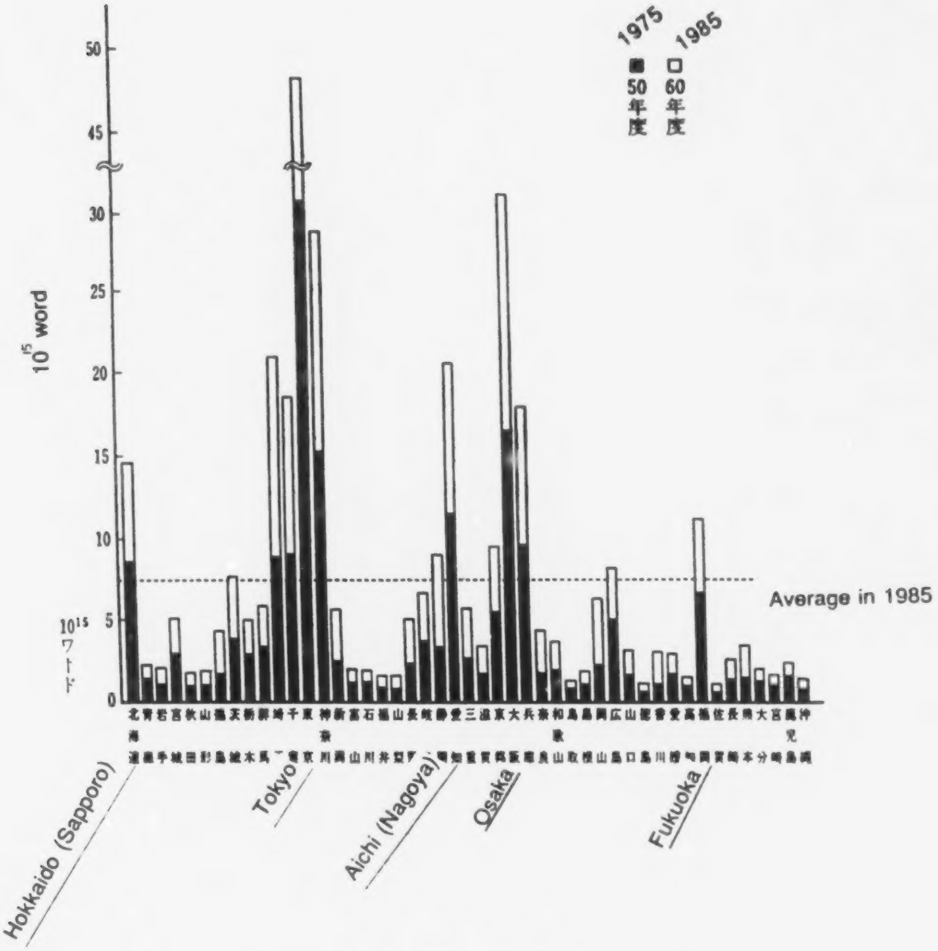
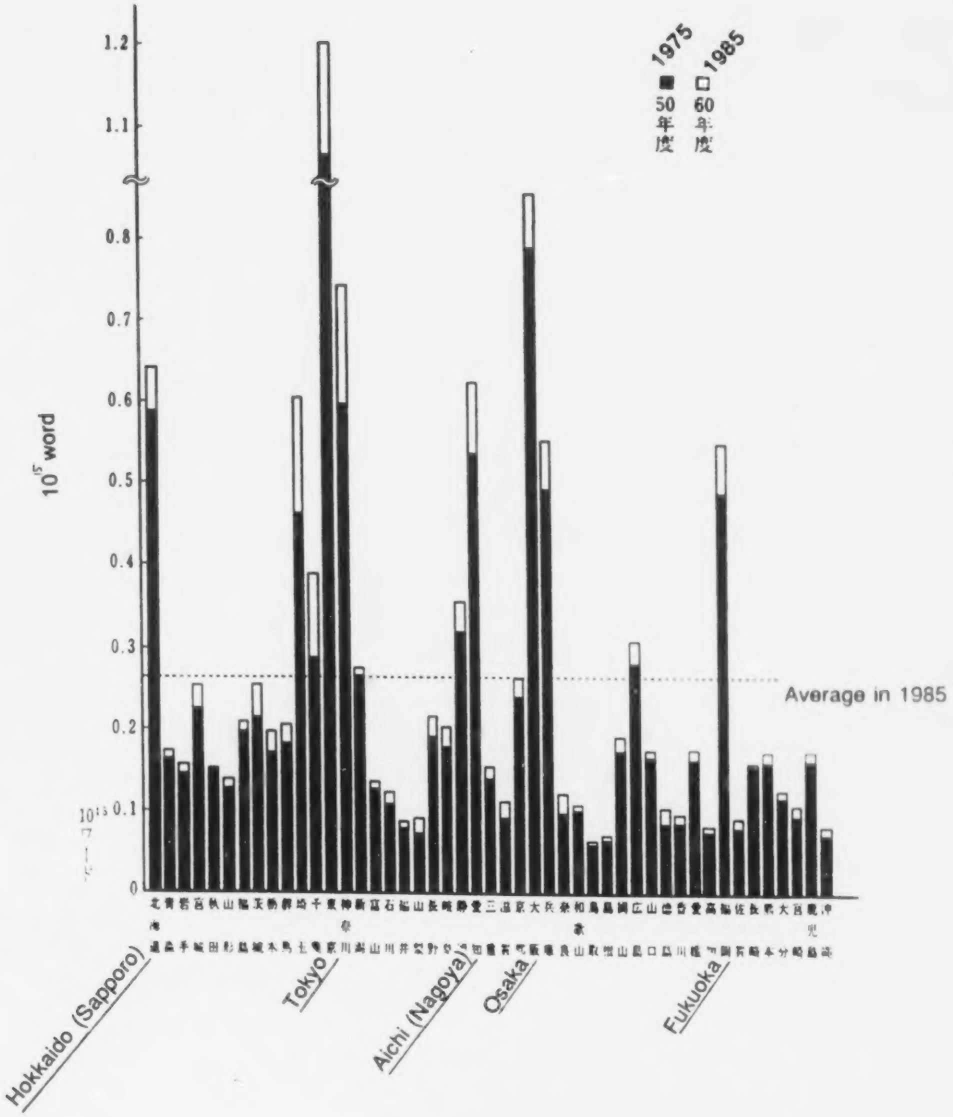


Figure 2 CONSUMPTION OF INFORMATION, BY PREFECTURE; 1975 AND 1985.

Source: Ministry of Posts and telecommunications, 1987



We adopted IA for the following reasons.

Firstly IA focuses on the functional aspect of information. We wished to include information created and processed in the secondary information division defined by Marc U. Porat (2). Our main interest concerning information is not only for industries which produce information as output but also other information created and processed (or used) throughout all economic activities. This is because the objective of this study is to analyze how information functions in carrying out economic activities. As IA takes into account all industries and occupations, both industries whose direct output is information itself and those whose direct output is not, the index enables the identification of statistical items which correspond to the secondary information division.

Secondly, the IA index enables one to distinguish seven categories of information activities. Differences between the categories come from difference in the level of autonomy allowed for each activity in creating and processing information. It follows that, among the seven categories, "A. Decision making and planning" is the most mentally-intensive activity and "F.Transmission and provision of information" is less so. The seventh category "G. Information equipment" denotes merely a manufacturing sector, and is not an activity which generates information directly.

The classification of IA defined in this way allows examination of the message contained in information in examining the influence of information on economic activities. Such classification is particularly useful in trying to find answers to the questions, such as; What kind, or what aspect of information influences economic activities? Do differences in the message conveyed by information result in different effects on economic activities?

Thirdly, the IA index enables one to enjoy benefits of existing statistical data. It is a great advantage to be able to make use of the National Census, the National Industrial Statistics, and the like, which are reasonably reliable and have been constantly collected over a number of years. In addition, use of a common data source allows scholars to improve application methodologies of IA by comparing the results.

It should be noted that in applying the idea of IA in our research, we eliminated some of the items listed, due to difficulties to obtain statistical data. For example, in Figure 3-2, it was not possible to break down "Clerical workers" to reclassify into each category of IA. The effect of this modification, however, is negligible because the value of eliminated data is sufficiently small.

4.2 INFORMATION POTENTIAL OF THE SUB-REGIONAL CENTERS IN TERMS OF IA BY INDUSTRY

This section analyses the characteristics of the information potential of the 43 sub-regional centers in Japan by using IA by industry. Among the seven categories of IA, "G. Information Equipment" is eliminated from the analysis since industries categorised in it do not generate information directly. Collecting data which correspond to each of the six categories of IA by industries from the Establishment Census of Japan 1986 (3), we applied a method of factor analysis to the cities examined.
Table 3 exhibits the results. 6 factors with eigenvalues of more than 1 are obtained. These 6 factors explain 71.5% of the total variance.

The first factor explains 27.1% of the total variance. The factor has strong correlations with the following industries; "Political, economic and cultural association", "Educational services", "Local government", "Religion" and "Communication". These industries represent central functions of the sub-regional centers in terms of political, administrative and cultural activities. Hence it is understood that these are the core activities which constitute the centrality of the sub-regional centers.

The second factor explains 16.2% of the total variance. The factor has strong correlations with the following industries; "Finance for agriculture, forestry and fishing ", "Institutions performing financial business or closely related functions" and "Broadcasting". The former two industries represent financial functions based on local cities. Hence it is understood that the second factor indicates functions as the economic center in terms of finance.

Figure 3 exhibits a scatter diagram of the first and the second sectors above.

Those cities, such as Yamaguchi and Nara, which have function as sub-regional centers merely because they are capitals of the prefectures have high scores in the first factor. In other words the core of their central function is information generated and obtained in the prefectural governments.

In contrast, industrial cities have low scores both in the first and the second factors. Cities such as Iwaki, Fukuyama, Kurashiki and Hamamatsu are examples of this type. They have strong industrial sectors but are not prefectural capitals.

Cities such as Morioka and Mito have high scores in the second factor. This indicates that they have strong functions as financial centers in the sub-regions.

Examination of the above leads to the conclusion that, from the viewpoint of information, three categories exist among the 43 cities;

a. Cities based on information in the prefectural governments,
b. Cities based on financial information, and
c. Cities based on corporate information which exist in the manufacturing sectors.

It merits attention that there are cities which exist on the basis of political and

Table 1 INFORMATION ACTIVITIES BY INDUSTRY

IA	Industries
A. Decision making and planning	-General construction
B. Creation and production of Information	-Research institutions (Universities, Laboratories, etc.) -Independent researchers -Advertising -Consultation and architectural services -Entertainment -Finance
C. Collection, storage and Provision of Information	-Newspaper, Publishing -Real estate -Information provision services
D. Processing of Information	-Printing -Business consultancy, Data processing -Legal and financial consultation -Other business services
E. Education and Training	-Schools -Social education
F. Transmission of Information	-Postal service -Telecommunications service -Theaters, Movie theaters -Broadcasting
G.Information Equipment	-Office machines -Computers, Integrated Circuit and other electronic appliances -Electronic measuring machines -Cables -Office utensils -Watches and clocks -Optical equipments

Table 2 INFORMATION ACTIVITIES BY OCCUPATION

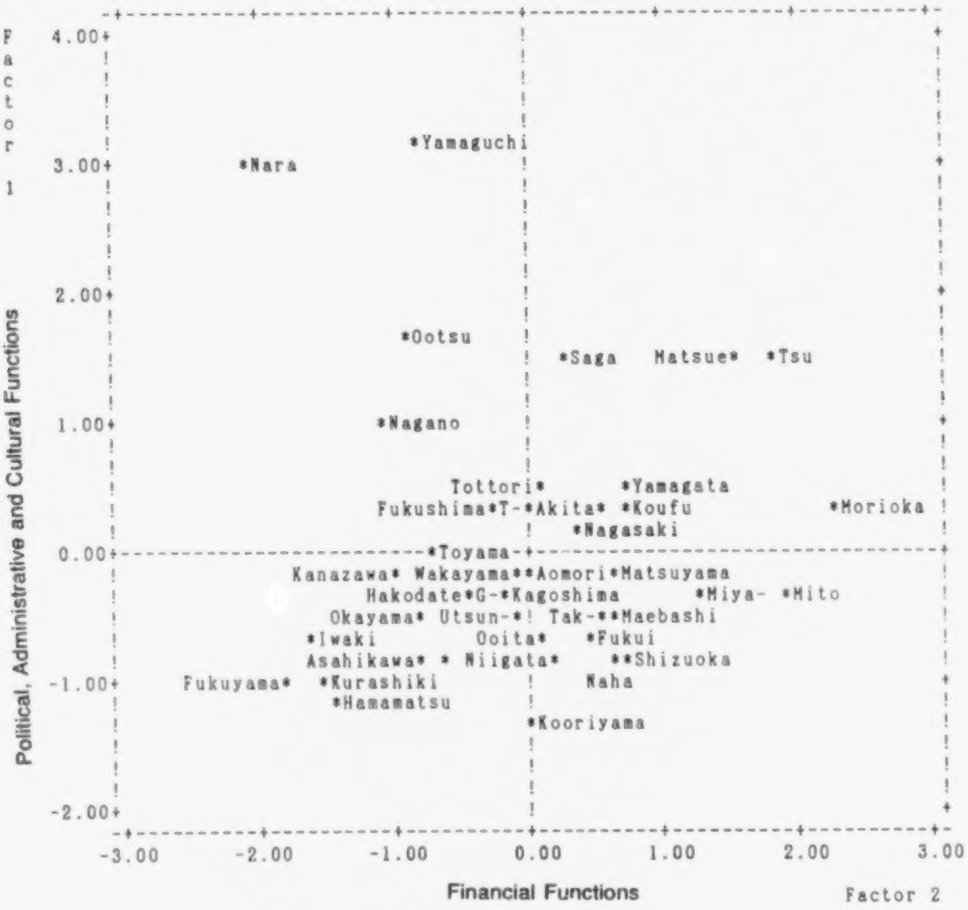
IA	Occupation
A. Decision making and planning	-Senior managers in the private sector -Senior officials in the public sector
B. Creation and production of Information	-Scientists, Engineers, Researchers -Artists, Photographers, Designers, Musicians -Novelists, Writers, Critics -Certain categories of clerical workers
C. Collection, storage and Provision of Information	-Journalists, Editors -Social workers -Certain categories of clerical workers
D. Processing of Information	-Lawyers, Prosecutors, Judges -Accountants -Certain categories of clerical workers -Workers in the Printing industry
E. Education and Training	-Teachers -Instructors
F. Transmission of Information	-Workers in the Postal service -Workers in the Telecommunications service -Certain categories of clerical workers
G.Information Equipment	N.A.

Table 3 FACTOR LOADINGS OF THE NUMBER OF EMPLOYEES OF THE INFORMATION-RELATED INDUSTRIES IN 1986

Information industry	Factor					
	1	2	3	4	5	6
1.Political,economic and cultural associations	.80					
2.Educational services	.79					
3.Local government	.78					
4.Religion	.76					
5.Communication	.74					
6.Agriculture,forestry and fishery finance		.75				
7.Institutions performing financial business or closely related functions		.73				
8.Insurance agents		.67				
9.Financial institutions for small sized enterprises, personal and housing credit agencies		.62				
10.Insurance brokers and services		.58				
11.Broadcasting		.54		.45		
12.Real estate			.87			
13.Professional services		.46	.72			
14.Motion pictures			.67			
15.Banks and trust companies			.46			
16.Publishing,printing and related industries				.91		
17.Information service, inquirement and advertisement				.71		
18.Central government					.79	
19.Securities dealers and commodity exchanges					-.73	
20.General construction						.64
21.Academic institutes	.42					.63
22.Other business services						.49
Contribution (%)	27.1	16.2	11.6	10.4	9.1	6.9
Cumulative contribution (%)	27.1	33.5	45.1	55.5	64.6	71.5

Factor loadings which are 0.4 or over are listed only.

Figure 3 SCATTER DIAGRAM OF FACTOR SCORES OF THE NUMBER OF EMPLOYEES OF THE INFORMATION-RELATED INDUSTRIES; FACTOR 1 BY FACTOR 2.



Factor1	Factor2	City
-0.58	0.54	Kouchi
0.40	0.01	Tokushima
-0.16	-0.09	Kumamoto
-0.32	-0.20	Gifu
-0.80	-0.62	Sendai
-0.52	-0.13	Utsunomiya
-0.57	0.59	Takamatsu
-0.27	1.24	Miyazaki

administrative information and those, on financial information. This in turn indicates "Political and administrative, and financial functions are NOT necessarily located in the same city". This hypothesis does not deny the fact that the financial sector tend to locate in the prefectural capitals, seeking after political and administrative information obtained in the prefectural government. There are many prefectural capitals which have developed a capability to generate and receive financial information accompanied by good accessibility to political and administrative information in the local government. Results of the factor analysis, however, may be worth consideration.

There is the fundamental difference between the prefectural capitals and the industrial cities in terms of the information they have. Information in the prefectural government is available to the public, whereas information in firms is not. As information from the local government is available, economic activities tend to locate in the prefectural capitals seeking after the information, followed by an accumulation of population. The prefectural governments have a wide variety of information, covering economy, social welfare, urban and regional planning, education and the like. It follows that a wide variety of firms and groups demand this information. In short, accessibility to a wide variety and a large quantity of information to the general public is one of the basic requirements for the economic development of cities.

4.3 INFORMATION POTENTIAL OF THE SUB-REGIONAL CENTERS IN TERMS OF IA BY OCCUPATION

This section presents a comparative examination of the location quotient of IA by occupations in the 43 cities under examination. Location Quotient (LQ) for each category of IA are calculated by the formula below:

(IA by occupation in the city i / Total number of workers in the city i) ÷
(IA by occupation in the 43 cities/Total number of workers in the 43 cities)

4.3.1 COMPARISON OF EACH CATEGORY OF IA IN 1965 WITH THOSE IN 1980

Table 4 depicts the standard deviations of location quotient for each category of IA by occupation.

Examination of the comparison between the two years for the 43 cities by Table 4 allows the following findings;

a. The standards deviation in all the six categories decreased in 1980. This indicates that difference of IA by occupation between the cities decreased during the 15 years.

b. The category "D. Processing of Information" exhibits the largest fluctuation between the cities. The value of this category, however, decreased in 1980, too.

Table 4 THE STANDARD DEVIATIONS OF IA BY OCCUPATION

	1965	1980*
A. Decision making	18.7	14.3
B. Creation and productionin	32.0	21.4
C. Collection and storage	21.5	14.3
D. Processing	56.7	32.4
E. Education and training	20.3	15.3
F. Transmission	21.3	19.8
SUM	16.3	9.1

* 1980 is the nearest census year to 1985

c. The category which exhibits the second largest fluctuation is "B. Creation and Production of Information". This is because of the characteristics of the occupations which belong to the category, such as scientists and engineers. These occupations tend to concentrate in certain cities, but do not spread over all cities.

d. Some categories exhibit almost the same level of the standard deviation. They are; in 1965, "A. Decision making and planning", "C. Collection, storage and provision of information", "E. Education and training", and "F. Transmission of information", and, in 1980, "A. Decision making and planning", "C. Collection, storage and provision of information", and "E. Education and training". The level of their standard deviations is relatively low, indicating that regional fluctuations in those categories are small. In other words, all the cities need to have a certain level of capabilities in decision making, collection and provision of information, and education and training. The fact that 36 out of the 43 cities under examination are the capitals of their prefectures may also explain the low levels of differences in those functions.

4.3.2. THE STANDARD DEVIATION OF LOCATION QUOTIENT

The ranking of the Standard Deviation (SV) of LQ of each category of IA (from A to F) of each city is shown below;

a. Five Cities with the Lowest Standard Deviation
(Cities in which distribution of each category of IA is fairly even)

1965	Kagoshima, Tokushima, Takamatsu, Miyazaki, and Kumamoto.
1980	Matsuyama, Niigata, Akita, Fukushima, and Okayama.

b. Five Cities with the Highest Standard Deviation
(Cities in which distribution of each category of IA is most uneven)

1965 Nagano, Ohtsu, Iwaki, Gifu, and Shizuoka.
1980 Nagano, Nara, Hakodate, Yamaguchi, and Ohtsu.

Cities where the distribution of each category of IA is fairly even can be said to be the cities with few distinguishing characteristics. Values of SD tend to be small in those cities that are single major city in their prefectures, such as Takamatsu (in Kagawa Prefecture), Matsuyama (in Ehime Prefecture), and Kagoshima (in Kagoshime Prefecture). This may be because, in these prefectures, activities to produce, process and transmit information to serve the whole prefecture are undertaken solely in the dominant cities.

Cities where the distribution of each category of IA is not even have one or two categories of IA which are outstandingly larger or smaller relative to other categories of IA. Nagano, for example, has a significantly large value "D. Processing of Information" both in 1965 and 1980. The same can be said of "B. Creation and Production of Information" for Ohtsu and Mito, "D." for Shizuoka, and "F. Transmission of Information" for Hakodate, Iwaki (1965) and Yamaguchi (1980).

The existence of an extra large value for some categories of IA reflects a concentration of employment in particular industries. The high value of "D." in Nagano, for example, is due the large volume of employment in the printing sector relative to other sectors.

Cities where industries are developing tend to have low values of LQ and, accordingly, the distribution of each category of IA exhibits a high level of fluctuation. Kooriyama and Iwaki in 1965 are examples of this type of city. An uneven distribution of categories of IA in some cities signals that they are "young" cities where industries are in the process of development, and where activities which generate, process and transmit information have not yet reached a stable stage.

5. INFORMATION ACTIVITIES AND URBAN ECONOMIC DEVELOPMENT

How does IA relate to the size and economic structure of the cities? This section is intended to analyse economic impacts of information generated and processed in a city by analyzing the correlation between IA and a set of indices used to indicate the size and economic structure of a city adopted in the field of urban studies.

IA by occupation is selected as an index which quantifies various activities which handle information. Any firm in any industrial sector has sections which produce information. Information produced and handled in these sections could have larger significance on economic activities than information produced as a marketable output. IA by industry does not allow for examination of information produced and consumed inside firms not in markets, i.e. information produced in the second information division defined by M.Porat, except for industries which produce information as commercial object. One of the advantages of IA by occupation, however, is that it embraces all the industries which contain jobs handling information within firms.

The Urban Variables (UVs) are adopted as indicators which express the size and economy of cities. UVs are composed of 24 variables, collected or created from several sources of the census data in 1965 and 1985 (4). The 24 UVs are exhibited in Tables 5 and 6.

Tables 5 and 6 exhibit the correlation coefficients between IA by occupation and UVs.

a. 1965

Many UVs exhibit correlation with each category of IA, especially UVs related to occupations and industries. UVs related to the size of the cities have relatively low level of correlation with IA. The population of the Densely Inhabited Districts (DID's) (5) does not show a strong correlation with any of the categories of IA, and population in the central area show strong correlation only with one of the UVs.

UVs related to occupations, namely, rates of managerial occupations, clerical workers, and professional and technical occupations, exhibit strong correlations with many of the categories of IA. In particular, the correlation co-efficient between managerial occupations and IA indicators is high. This may be because where there are many managers and administrators, whose main information activities is decision-making and planning, there are also many workers to support their activities.

UVs related to industries exhibit fairly strong correlations with IA. For example, rates of workers in "Finance, insurance and real estate", "Wholesale and retail trade", "Services", "Transport and communications" and "Government" indicate high levels of correlation with many of the categories of IA.

b. 1985

The levels of correlation coefficients became lower than in 1965 in general terms. The number of meaningful value of correlation coefficients decreased in many of the occupation- and industry- related UVs.

Some exceptions are the rates of "Workers educated at colleges or universities", and workers in "Construction" and "Transport and communications". The number of correlation coefficients with meaningful value increased in the former, and, in the latter two, values of negative correlation coefficients increased in relation to "A. Decision making and planning", "B. Creation and production of information", "E. Education" and "SUM". One of the possible reason to explain the former change is that those who have high levels of education have more opportunities to obtain occupations which involve high levels of autonomy in handling

Table 5 CORRELATION COEFFICIENTS BETWEEN IA BY OCCUPATION AND URBAN VARIABLES; 1965.

	Information Activities by Occupations						
	A.	B.	C.	D.	E.	F.	SUM
1.Population	0.319						
2.DID Population							
3.Population change of each city 1960-1965, rate(%)						-0.323	
4.Population of under 15 years old, rate(%)	-0.551	-0.423	-0.479				-0.525
5.Population of 65 years old and over, rate(%)			0.390		0.352		
6.Labour force of female, rate(%)						-0.381	
7.Workers educated at colleges or universities	0.372	0.352					
8.Professional and technical workers		0.367	0.710		0.843	0.415	0.678
9.Managers and administrators	0.796	0.452	0.360	0.519	0.443		0.767
10.Clerical workers	0.340	0.376	0.493	0.417	0.569	0.442	0.667
11.Sales workers	0.533	0.341	0.489				0.532
12.Craftsmen,production process workers and laboureres					-0.495	-0.336	
13.Construction			0.401			0.387	0.347
14.Manufacturing	0.434						
15.Wholesale and retail trade	0.474		0.574		0.433	0.414	0.628
16.Finance,insurance and real estate	0.546		0.600	0.465	0.584	0.497	0.774
17.Transport and communications			0.430	0.333		0.419	0.471
18.Services			0.655		0.639	0.473	0.629
19.Government			0.414		0.581	0.363	0.430
20.Amount of yearly wholesale per capita	0.486			0.319			
21.Amount of yearly retail per capita	0.534	0.352		0.440			0.551
22.Yearly value added of industyrial goods per capita			-0.352		-0.615		-0.371
23.Deposits and savings per capita	0.386						0.354
24.Maximum price of land	0.353						

Information Activities by Occupations, A to F are same as Table 3-2. SUM means total of A to F. 7 to 19 are ratio(%) of each employee to total employees. Only correlation coefficients which are significant at $\alpha=0.05$ level are listed.

Table 6 CORRELATION COEFFICIENTS BETWEEN IA BY OCCUPATION AND URBAN VARIABLES; 1985.

	Information Activities by Occupations						
	A.	B.	C.	D.	E.	F.	SUM
1.Population							
2.DID Population							
3.Population change of each city 1980-1985, rate(%)		0.510			0.359		
4.Population of under 15 years old, rate(%)							
5.Population of 65 years old and over, rate(%)							
6.Labour force of female, rate(%)							
7.Workers educated at colleges or universities	0.479	0.426			0.488		0.462
8.Professional and technical workers		0.547	0.422		0.591		0.588
9.Managers and administrators	0.794	0.441			0.328		0.669
10.Clerical workers		0.334		0.353			0.343
11.Sales workers							
12.Craftsmen,production process workers and labourers							
13.Construction	-0.371	-0.351			-0.475	0.345	-0.431
14.Manufacturing	0.323					-0.355	
15.Wholesale and retail trade							
16.Finance,insurance and real estate							0.400
17.Transport and communications	-0.373	-0.382			-0.405	0.524	-0.386
18.Services			0.448				
19.Government	-0.427					0.514	
20.Amount of yearly wholesale per capita				0.455			
21.Amount of yearly retail per capita	0.306						
22.Yearly value added of industrial goods per capita							
23.Deposits and savins per capita	0.480	0.378		0.398			0.510
24.Maximum price of land							

Information Activities by Occupations, A to F are same as Table 3-2. SUM means total of A to F. 7 to 19 are ratio(%) of each employee to total employees. Only correlation coefficients which are significant at α=0.05 level are listed.

information. To explain the latter, it may be said that many of workers in "Construction", and "Transport and communications" sectors hardly handle information.

Among the UVs above, rates of workers in "Construction" and "Transport and communications" indicate meaningful and positive correlation coefficients with one category of IA, "F. Transmission of information". This indicates that information activities categorized in "F. Transmission of information" have a close relationship with economic activities. A statement that "It is foreseen that, in the future, where information is actively generated, the rate of those taking occupations in activities categorized as simple transmission or processing of information will be relatively small" (6) is becoming true as far as transmission of information is concerned. The rate of those who take occupations which transmit information no longer relates to the volume of information transmitted.

"Deposits and savings per capita" exhibits a meaningful correlation coefficient in relation to "B. Creation and production of information" and "D. Processing of information" in 1985, in addition to "A. Decision making and planning" and "SUM", with which "Deposits and savings per capita" already indicated the existence of a meaningful correlation in 1960. This indicates a relationship that where there is information, there is money.

Why was there an overall decrease in the values of correlation coefficients from 1965 to 1985? The 1960s was an era in which manufacturing was the engine of growth pulling the Japanese national economy. Those cities which had the manufacturing sector developed in this period. As the cities grew and their residents became more wealthy, the demand for services also grew. Consequently, since the 1960s, service activities developed and created employment opportunities alongside those in the manufacturing sector. The service sectors such as finance and insurance, and wholesale and the retail trade are examples of these. As occupational IA's in these sectors are information-intensive, they exhibit higher levels in production, processing and transmission of information than the manufacturing sector. This is the reason why correlation coefficients between the service-related sectors and IA was high in 1965. In short information-intensive activities developed following the development of the manufacturing sector in the 1960s. This in turn means that in those cities where no or little development took place in the manufacturing sector in this era, the level of accumulation of information was correspondingly small.

In 1985, however, the correlation between industrial development and IA became obviously weaker than in 1965. This phenomena is interpreted as an outcome of the emergence of the so called "Soft-economy" or "Service-economy" in these sub-regional centres, rather than saturation of the growth in the manufacturing sector. The wealth generated by the manufacturing sector had spread all over the country, including cities which did not previously have a manufacturing industry as a major source of wealth. All the cities started to grow and so did the service sectors between 1965 and 1980. The number of information-intensive occupations in all industries developed in the previous 20 years increased and constituted the basis for economic activities in Japan. Thus the relatively strong tie between IA and some service sectors has disappeared. Similarly the level of variation of their correlation coefficients in the labor market composition of the cities (i.e. the level of dispersal of the IA index) has decreased over time.

In summary it can be said that the overall decrease in the levels of correlation coefficients indicates the development of "informatization" of the economy. M. Porat argued, in "The Information Economy", that wealth generated by the first and second information sector occupied 46% of the Gross National Product (GNP) in 1967, and stimulated discussion that the economy in the United States of America had entered a new stage of economic growth based on information. It was argued by the Research Institute of Telecommunications Economy (RITE) in 19847 that the same occurred in Japan between 1960 and 1980. This took place in the sub-regional centers in Japan.

6. CONCLUSION

An analysis of IA by industry results in the finding that there are two kinds of information which constitute the basis of the cities; governmental information and financial information. Distinction between these two types merits attention in further examining the impact of information in urban development.

An analysis of IA by occupation leads to the finding that there are two types of cities, i.e. those developed on the basis of the manufacturing sector, or "manufacture-pulled" cities (in the 1960s), and those developed on the basis of information gathered there, or "information-pulled" cities (in the 1980s). This reflects the fact that the "Information society" has developed on the basis of the "Industrial society". The mechanism to create, process and transmit information within social networks have been formed as a result of development of the manufacturing sector in Japan.

After the oil shocks during the 1970s, the Japanese economy could not rely too much on the manufacturing sector due to the rapid increase of material and energy costs. Instead, those industries that rely on the creating and producing of information became an engine to develop the cities. In other words, generation of information in the sub-regional centers after the oil shock had an independent role to push development of the cities, not necessarily being associated with the development of the manufacturing sector.

Regional development and development of the

"Soft-economy" in Japan are both sides of the same coin now. Under the environment of the "Soft-economy", value added to products, information or services rather than products themselves weigh much on economic transactions. One of the tasks for the sub-regional centers for their development toward the next century is to build a mechanism to create and produce information which enhances their importance.

7. POLICY IMPLICATIONS

Three tasks for policy makers involved in the development of information systems and regional planning arise from the analysis in this study. These are; creativity of information, money and information, and infrastructure planning for communications systems.

Creativity of information

Enhancement of the capability to create information, especially the decision-making function, is the key to the economic development of sub-regional centres. Where decision-making functions exist, economic activities grows. Decision makers, such as politicians and senior managers, need information to achieve their tasks. The decision-making process itself also generates a variety of information. Interest groups form around decision-makers to influence or to obtain benefit from the decision. The task for regional development for policy makers is to build a mechanism which helps to enhance the capability of human resources to create and generate information, which may not be available in any other regions.

Money and information

The relationship between money and information deserves attention in the context of urban and regional planning. A money flow is often accompanied by an information flow. The amount, origin and destination of money flow indicate the decision-making function behind the flow. Policy makers should take into account the value of information attached to money flow in planning the economic development of regions.

Infrastructure planning for communications systems

The planning of an information infrastructure should be incorporated in the policy for regional economic development. Where vital economic activities take place, information is accumulated. Accumulation and interaction between various kinds of information generates new information. Those who are involved in such activities are often heavy users of the information infrastructure, such as enhanced information networks and media. The strategic use of infrastructure to assist in the creation of information should be one of the tasks achieved by planning for regional development.

REFERENCES

Marc Uri Porat, "The Information Economy; Definition and Measurement", Department of Commerce, the U.S.A., 1977

"An approach to calculation of the information economy", the EPA, Tokyo, 1985, p27 (Original in Japanese, translation by the authors)

"Information Potential in Japanese Regions" (Original in Japanese, translation by the authors), Agency of Regional Planning, Tokyo, 1987, p.183

"Study of the current development of information-related industries in Japan" (Original in Japanese), RITE, Tokyo, 1984

"1987 Communications White Paper"(Original in Japanese), the Ministry of Posts and Telecommunications, Tokyo, 1987

NOTES

(1). The EPA (1985), p27, (Translation by the author).

(2). Marc Uri Porat (1977).

(3). The year 1986 is the closest census year of the Establishment census to the year 1985.

(4). Some of the data is for the closest year to 1985, due to the availability constraints.

(5). An area or areas in a city composed of a group of contiguous enumeration districts each of whose population density is 4,000 or more per square kilometer, and whose total population exceeds 5,000.

(6). Agency of Regional Planning, (1987), p.183.

(7). RITE (1984).

APPENDIX

The 43 Cities and their populations, as of 1985

Cities	Population
Hakodate	319,194
Asahikawa	363,631
Aomori	294,045
Morioka	235,469
Sendai	700,254
Akita	296,400
Yamagata	245,158
Fukushima	270,762
Kooriyama	301,673
Iwaki	350,569
Mito	228,985
Utsunomiya	405,375
Maebashi	277,319
Niigata	475,630
Toyama	314,111
Kanazawa	430,481
Fukui	250,261
Koufu	202,405
Nagano	336,973
gifu	411,743
Shizuoka	468,362
Hamamatsu	514,118
Tsu	150,690
Ootsu	234,551
Nara	327,702
Wakayama	401,352
Tottori	137,060
Matsue	140,005
Okayama	572,479
Kurashiki	413,632
Fukuyama	360,261
Yamaguchi	124,213
Tokushima	257,884
Takamatsu	326,999
Matsuyama	426,658
Kouchi	312,241
Saga	168,252
Nagasaki	449,382
Kumamoto	555,719
Ooita	390,096
Miyazaki	279,114
Kagishima	530,502
Naha	303,674

Source: National Census of Japan, 1985.

THE IMPACT OF DESKTOP PUBLISHING ON THE PACIFIC ISLANDS PRESS

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1. Abstract

Desktop use by Pacific Island news publishers approximates that in the United States only five years after its introduction into the region. This paper examines the forces behind this ready acceptance of the new technology, and explores what impact it may have on the future of regional print news media.

2. DESKTOP PUBLISHING IN THE PACIFIC

Tom Lloyd, publisher of the Norfolk Islander, appears to have been the first in the region to recognize the value of desktop publishing (DTP) systems, when he purchased a Macintosh and laser printer in 1985 (Richstad, 1989; personal communication). Within four years, one-third of all news periodicals in the region were using similar systems, either in-house or commercially (Layton, 1989).

This rapid acceptance of new technology is unusual in a region characterized by information poverty, communication difficulties, and a lack of indigenous capital. Even more surprising, the proportion of Pacific Island publishers using DTP falls well within that estimated in the United States by the American National Newspaper Association - between thirty and fifty percent (Underwood, 1989).

Most Pacific Island desktop users are established publishers seeking greater production efficiency and a more professional product. Seven of the twenty-two newspapers which were started before 1973 - Samoa News, Tonga Chronicle, Ko E Kalonikali Tonga, Cook Island Daily News, Norfolk Islander, and Wantok - now use Apple hardware (Macintosh, Mac II) and DTP software (Pagemaker, MacDraw, Cricket, Ready Set Go and Word) (Richstad et al, 1973; Layton, 1989). More recently appearing papers such as the Samoa Observer and The Times of Papua New Guinea have also followed suit.

This paper discusses some of the major considerations behind the ready acceptance of the new technology by Pacific Island publishers, and explores what impact it may have on the future of regional print news media.

3. FORCES FOR CHANGE

Ten years ago, Anthony Smith wrote of the U.S. press,

> "The newspaper is more than ordinarily conservative. Its complex linkages to society force it to change its structure and system only when absolutely obliged to do so; and then it tends to be in something of a rush. It is continually being posed with the problem of simple survival." (Smith, 1978)

Simple survival has likewise been an FDongoing preoccupation among Pacific Island publishers. Press development has been historically contained by isolation, cultural diversity, small advertising markets, a reliance on imported (ie expensive) equipment and supplies, and limited discretionary income on the part of consumers. Production technology generally reflected the tenuous financial environment within which most publishers operated. Many papers were typeset on ancient manual typewriters and reproduced by mimeograph or letterpress well into the early 1980s. Today, however, an increasing trend on the part of publishers to experiment with new technological solutions has resulted from institutional, technological, economic and social development in the regional press environment over the last twenty years.

3.1 INSTITUTIONAL CONSIDERATIONS

Although newspapers have been published in the region for over 150 years, it is only over the last two decades that the Fourth Estate has been consolidated in the Pacific. The number of newspapers and the number of copies circulating are today twice that of 1973 levels, with the greatest circulation gains seen in the independent press (Layton, 1990). Significantly, these increases have outpaced regional population growth (50% versus 42% between 1973-1989) - considered one of the world's highest (ibid).

The circulation of daily newspapers, in particular, rose by over half between 1973 and 1989. This suggests a greater management emphasis on the business aspects of publishing (better financial management, positioning and sales) larger markets, better distribution networks and healthier profits. In addition, papers themselves have grown in size and now average 40% more pages per issue (ibid).

This newly-developed institutional maturity has been accompanied by increased links between news professionals in the various Pacific Islands. Notable has been the rise in professional associations such as the Pacific Islands News Association (PINA), which held its inaugural meeting in 1974. PINA was the vanguard for the creation of these networks, with national journalists associations and press councils soon following. Today the associations provide forums for the discussion of relevant professional issues as well as function as clearinghouses for management, training and technical information.

The increasing emphasis on publishing as a business has made profitability a popular topic at workshops and conferences. At the 1989 PINA meeting in Honiara, the workshop "Making Money From Newspapers" was attended by the majority of publishers at the meeting, including those from the government papers. PINA 1989/1990 workshops on DTP were likewise well-attended, in recognition of DTP's innovative contributions to profitable business decision-making.

3.2 TECHNOLOGICAL FACTORS

According to Peter Romano, Director of Technical Services for the American Newspaper Publishers Association, there is good reason for this high interest in DTP;

> "Smaller circulation newspapers have traditionally required innovative solutions to complex problems in order to stay within smaller budget constraints." (Romano, 1988)

The introduction of personal computer technology a decade ago in the U.S. revolutionized newspaper operations. Traditional 'front end' computerized systems had been slow, of limited application and priced out of range of the smaller papers such as those operating in the Pacific until the advent of the minicomputer. In the early 1980s, technological development and market forces squeezed out a number of traditional 'front end' vendors, and those that remained srove to incorporate personal computer (PC) technology into their editorial and production packages (ibid). The intense competition between PC manufacturers which followed resulted in the development and production of DTP systems increasingly appropriate for use in the Pacific Island setting.

The print quality of the finished product, however, remained a particular problem until laser printer technology caught up with the advances in computerization in the mid to late 1980s.

It was only a few years ago that hardware and software became more integrated, more reliable and more user friendly to be attractive, and inexpensive, enough to overcome the technological conservatism characteristic of both the region and its shoestring publishing operations.

3.3 LABOR ISSUES

Ongoing labor concerns in the publishing industry also made these new systems very attractive, though in a different context to that of North America. Small Pacific Island populations are characterized by a limited pool of skilled labor. With less people, period, there are less people to be found with publishing-related skills such as journalism, graphic design, typesetting, layout and printing.

In addition, to the ambiguous nature of news publishing in the Pacific makes retaining staff problematic. While the number of journalists employed full-time in the region has increased fourfold between 1973 and 1989, the average journalists' career is a short one (Layton, 1990).

> "(The) journalism profession in Papua New Guinea (has) no professionally recognised status. Hence there is no respect, pride, dignity...there is no distinction between a journalist and a government clerk." (Nash, 1989).

Low pay, difficult working conditions and few benefits also serve to limit a journalist's time in a particular organization, or in news publishing generally. Many leave for often unrelated employment with the government, either in politics or the public service. While improved working conditions for journalists is beginning to be discussed, it will be a long time before newspaper employment packages will come close to that of the coveted public sector (and all its 'perks').

> "The driving force for computerization is the labor shortage. What a computer does is give people more productivity with the same labor force. " (Rising, 1990)

The fact that the skilled people are few and somewhat transient tends to preoccupy management with personnel issues to the detriment of editorial, finance or distribution strategy development. Desktop publishing technology, however, packages a wide number of publishing-related skills and makes them available to a single operator. Production and editorial tasks can be completed more efficiently, more professionally and with far fewer people than with conventional systems. As a result, costly production resources are freed up with DTP and can be applied instead to improving news collection or advertising sales.

The projected loss of production jobs has not drawn battle lines between management and staff as it has done in the United States. Pacific Island production staff are for the most part non-unionized, and Pacific Island publishers are therefore less susceptible to the demarcation-fueled pagination debates which have inhibited the full use of this technology in the United States and Australia.

The recognition of DTP's value in rationalizing island newspaper organizational structures coupled with the lack of trade union constraints were two major reasons why the new technology was adopted so readily.

3.4 FINANCIAL CONSIDERATIONS

In the end, however, perhaps the most influential factor in the introduction of DTP into the Pacific concerned price. The early 'front end' computer systems offered a number of advantages over letterpress, but costs were prohibitive for the small newspaper. The combination of technological breakthroughs and heightened competition between vendors, however, resulted in a fall in hardware and software prices that were phenomenal in the 1980s. Romano (1988) makes the point that if automobile prices had followed the same trajectory as that of computer memory, it would be possible to buy a Rolls Royce for $1 today.

DTP technology minimizes the newspaper start-up risk for would-be Pacific Island publishers. The low capital and maintenance costs of DTP systems reduce the level of investment required to launch a title and keep it on a regular production schedule while building up circulation and advertising revenue (Cass, 1990).

It also allows established publishers to integrate new services into their marketing mix, while providing them with the means to underwrite development costs. Word Publishing, which publishes The Times of Papua New Guinea, Wantok, Rugby League News, PNG Trade Monthly, Travellers Times and Weekend Sport, installed eight Macs in their newsroom and advertising department in late 1986. Since that time newspaper revenue has been augmented through their job printing service (Solomon, 1989; personal communication).

4. IMPACT

Diversity as defined by the number of titles being published and the differing patterns of ownership is becoming more characteristic of the regional press than it has been in the past.

Trends identified in a recent study also indicate a greater involvement by Pacific Islanders in print news publishing (Layton, 1989). More journalists - overwhelmingly indigenous - are being employed, more locals are taking over editorial slots once reserved for expatriates and more news is appearing in the first languages of the region's citizens.

However, governments have been stymied by the lack of interest on the part of indigenous investors in their campaigns to localize media ownership. Capital is limited and investors are more perhaps more cautious than their counterparts elsewhere. The advent of simple, integrated and inexpensive desktop systems promise much in the way of reducing the precarious nature of a newspaper start-up. The already wide acceptance of desktop publishing technology will most likely catalyse a new trend to Pacific Island ownership of print media within the coming decade.

Increased production efficiency through DTP has allowed at least one notable island newspaper, the Samoa Observer, to increase its news content and page length considerably. Like many other commercial papers which have converted to desktop systems, the cleaner typesetting and page layout has attracted both readers and advertisers.

DTP has also begun to strengthen the links between newspapers in the various Pacific Islands. Pacnews, the regional news service launched by the Pacific Islands Broadcasting Association (PIBA) in 1987, gathers, edits and disseminates news from thirteen Pacific Island nations. The editing of Pacnews reports distinguishes the service from other Third World agencies, which primarily distribute government press releases. It is also unusual because of the interest shown in it by regional print media, even though it is targeted at broadcasters. The Samoa Daily News, Cook Island Daily News and the Marshall Islands Journal - all of which are desktop published - run Pacnews reports in their regional news sections. Though the reports are currently faxed to subscribers, the interest of DTP newspapers stimulated discussion at the 1989 and 1990 PINA conferences about the possibility of also offering the service by modem.

Finally, the factors which combine to overcome obstacles inherent in commercial publishing in the Pacific, make DTP attractive to the government, church and other non-profit presses as well. These newsletters and newspapers, even more than the independents, are constrained by limitations of finance and personnel. Already in Papua New Guinea, the National Information Service has conducted several DTP workshops with women's and other community groups, and is working to set up DTP-based modem linkages with each of the country's nineteen provincial divisions of information.

Desktop publishing offers enormous potential as a business, as well as a medium for education, information and entertainment in the Pacific. It is therefore likely that the coming years will see a blossoming of viable new titles to serve a variety of cultural, language or other special interest groups.

5. CITATIONS

Cass, P. "Desktop Publishing and the Future of the Newspaper Industry." Media Information Australia. No. 56, May 1990: 43-47.

Layton, S. "The Changing Pacific Island Press." Australian Journalism Review. December 1989: 125-138.

---------- "The Contemporary Pacific Islands Press." International Communication Bulletin. vol. 25 no. 3-4 (Fall 1990).

Nash, S. "Status of Journalism in Papua New Guinea." Paper presented at the IFJ Meeting in Port Moresby, PNG; September 13-15, 1989.

Richstad, J., McMillan, M. and Barney, R. *The Pacific Islands Press: A Directory*. Honolulu: University Press of Hawaii, 1973.

Richstad, J. Professor of Journalism, University of Oklahoma. Personal communication. Honolulu; December 1989.

Rising, R. R. "Computer Solutions". Guam Business News. January 1990:14-24.

Romano, P. "Where Newspaper Technology is Heading." PANPA Bulletin. April 1988:64-69.

Smith, Anthony. "The Future of the Newspaper: The Waning of the Fourth Estate". Intermedia. vol.6 no.4 (August 1978):6-25.

Solomon, Anna. Publisher of The Times of Papua New Guinea and Wantok. Personal communication. Honiara; October 1989.

Underwood. D. "The Desktop Challenge". Columbia Journalism Review., May/June 1989:43-45.

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Japanese Cultural Autonomy and American Impact: Japanese Adolescents' Perceptions Toward Media & Popular Culture

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1. ABSTRACT

To what extent has Japan kept its cultural autonomy in the face of the outpouring of American popular culture since the end of World War II? A survey was conducted with 111 eighth graders and 150 high school freshmen from randomly selected institutions in Kyoto and Gifu, examining adolescents' perceptions of popular culture. Results indicate that television and perceptions of American and Japanese popular culture are related in quite different ways than first thought.

2. INTRODUCTION

It has been more than a quarter of a century since McLuhan (1964) coined the phrase "global village." McLuhan argued that humans no longer lived in segmented, isolated social circles or tribes, which had come about largely because of the effects of print media. Electronic media, particularly TV, he said, have allowed humans to experience one another across cultures in an open and complete way. These media were well on the way to recreating and "retribalizing" a communal society or "the family of man" (Edmundson, 1984). The idea is plausible. TV and other media are major sources of information in most cultures today. On the other hand, because advanced technology and software programming tends to originate in the more developed countries of the world, a biased pool of information can be propagated, spreading from the highly industrialized western and northern cultures to the eastern and southern (1).

Japan achieved outstanding development success in the post-World War II era. Japan has its own sophisticated communications technology, said to be "the most highly developed in the world" (Whetmore, 1987, p. 302) and its own skilled programmers and producers of media messages, which include traditional Japanese theater and cultural programs. However, American TV shows, personalities and popular culture constitute a large proportion of what is broadcast over Japanese TV. Concerns have been expressed regarding the dangers of cultural domination, which takes the form of dependence on imported models reflecting alien life-styles and values (MacBride, 1980; Servaes, 1989).

The essential concern in Japan is whether the country can borrow popular programs from the U.S. and from other countries on a very frequent basis during the process of modernization and expansion, but still retain its traditional values and essential cultural elements (Lubis, 1986; Tsujimura, 1987). We focus on adolescents in this study, because they are perhaps most responsive to popular culture of all age groups and because they were born during a period of technological and economic growth and prosperity, which led to significant and relatively rapid social change (Masuda, 1980).

3. CONCEPTS AND DEFINITIONS

We examine five concepts which are briefly defined next. Americanization, and U.S. image, involve a process among non-Americans whereby they make an overall positive or negative evaluation of varying degrees of intensity concerning the United States of America, and the extent to which they consciously or unconsciously change their ideas and life styles so that they become more or less similar to Americans, based on their perceptions of the American system, technically, socially, culturally, politically, and economically (Yoshimoto, 1989). *Popular culture* is defined as contemporary culture which focuses particularly on language, personal appearance, dress, music, art, dance, consumerism, etc. supported by people as a mass, but not necessarily supported by all groups in the society and which is separate from high, elite culture and folk culture (Jacobs, 1961; McQuail, 1987; Rosenberg and White, 1957, 1971; Whetmore, 1987). *Technological determinism* is the idea that communication technologies determine culture (Schramm, 1973), and may be illustrated by two different points of view: (1) the optimistic McLuhan view that such technology brings all social and political functions together and heightens awareness of responsibility for being a part of an increasingly interdependent world to an intense degree, and (2) the pessimistic view of Innis (1951) and others, who held that such technologies have dangerous implications for the vitality of an oral tradition and for the health of a civilization, particularly if they prevent people from being interested in existing culture. *TV exposure* includes not only the time people are exposed to television, but also their motivations, perceptions, levels of knowledge, attitudes, behaviors, and other consequences of such viewing. The concept of *global village* has already been mentioned, and refers to a sense of belongingness to and kinship with, all humans in all cultures of the world, as a function of exposure to nearly instantaneous news and ubiquitous entertainment from all corners of the world, as well as enhanced opportunities to communicate across cultures.

4. HYPOTHESES

Four hypotheses were examined. Two dealt with possible effects of increased TV exposure, positing that interest in American popular culture would increase, but that partiality toward Japanese popular culture would decrease. A third hypothesis held that as interest in American popular culture increased, interest in Japanese popular culture would decrease. Finally, we hypothesized that as interest in American popular culture increased, the U. S. image would become stronger and more positive. An alpha level of </= .05 was selected to reject the null hypotheses implied. A guiding principle underlying these hypotheses is that TV exposure is a presumed cause leading to an increase in the global village phenomenon, an increase in interest in popular culture (especially American popular culture), and increased Americanization via enhanced U. S. image.

5. METHODS

The sample consisted of 111 eight graders and 150 high school freshmen from ages 13-16 attending randomly selected public educational instituions in Kyoto and Gifu, suburbs of Osaka and Nagoya. The cities are approximately 100 km. apart and are located in central Japan. They receive the same broadcast channels, except for one local UHF channel each. The Japanese character is such that individuals wish to share common values (Haglund, 1984; Reischauer, 1977), thus placing centrally produced programs from large urban areas such as Tokyo and Osaka at a viewing premium (Ochi, 1966).

The survey instrument contained 30 questions, including demographic variables. The first half assessed behaviors and the second half measured attitudes. The major measurement technique was the semantic differential scale, which used 7-point continua and bipolar adjectives (e.g., superior, inferior) in relation to such referents as "United States" (Martin, 1986). The instrument was in Japanese and was carefully pilot tested and revised before actual administration. The whole population of the age groups targeted and present in school on the days of the survey (January 9 and 10, for the younger age group and January 17 and 18, 1990 for the older students) filled out self-administered survey instruments.

6. RESULTS

Females made up 51.8% of the 261 respondents. Average age was 15 years. Only two respondents had lived overseas (one in England and the other in Korea). Asked which foreign country first came to mind, 76.2% named the U.S. A further question established that, other than Japan, the culture the adolescents were most interested in was the U.S., which they felt dominated their awareness because of the emphasis placed on the U.S. by the mass media.

The average amount of time spent with TV was 13 hours per week (ranging from one to 48 hours). Respondents were asked to name the most important reason for viewing TV. Their answers were: for entertainment (59.1%), to pass time (12.5%), out of habit (12%), to get information (6.3%), to know what is happening in the world (5.3%), and to be well-informed about current issues (4.3%). The most frequently watched shows were dramas (48.6%), followed by comedies (18.3%). The least watched program type was the talk show (0.5%). As for news shows, 48% said they mostly paid attention to national news, followed by 25.4% who paid most attention to world news, and 10.5% who paid most attention to local news. However, 16.1% said they did not watch any news shows.

Nearly three in five adolescents indicated they were somewhat or very interested in American popular culture (58.8%). Only 17.1% said they were not very or not at all interested. The balance were not sure (24.1%). From the majority group, the major topic of interest was American movies (80.8%), followed by rock music (46.4%). On the other hand, few were interested in American magazines or novels (3.3% and 6% respectively). Interestingly, only 15.9% said they were interested in American television programs and half of them could not name any U.S. show being broadcast during the time of the survey. Among the most popular U.S. shows were Little House on the Prairie, Murder She Wrote, and Sesame Street, all of which were broadcast on Nippon Hoso Kyoku (NHK). Among those students interested in American popular culture, 54.1% also were interested in domestic-made Japanese TV shows which were filmed partly or wholly overseas.

More than four in five Japanese adolescents said they were somewhat or very interested in Japanese popular culture (81%). Only 8.5% said they were not very or not at all interested. The balance were not sure (10.5%). Among the somewhat or very interested group, 76.6% were interested in Japanese TV programs, followed by Japanese rock music (65.1%), magazines (54.5%), movies (47.4%), teenage-singer idol songs (31.3%), and novels (30.6%).

Because we used interval level or dummy variable measurement for relevant single variable measures, as well as multiple item scale scoring procedures to measure concepts of interest, our hypotheses were tested using Pearson product-moment correlation coefficients.

Increased exposure to TV had a slight negative relationship to personal interest in American popular culture (r = -.02, 2-tailed p = .742, N = 253) and a slight negative relationship to personal interest in Japanese popular culture (r = -.04, 1-tailed p = .273, N = 253). The direction of the first correlation was in opposite of the predicted direction. The relationship between TV exposure and interest in Japanese popular culture can be tested several additional ways. The relationship between TV exposure and perception of people who actively seek Japanese popular culture, for example, was -.12 (1-tailed p = .031, N = 249). This supports the hypothesis. And, the correlation between TV exposure and feeling towards people who malign Japanese popular culture was -.10 (2-tailed p = .10, N = 250). Perception of others' feelings toward Japanese popular culture was coded so that a high score meant a positive perception of those who malign Japanese popular culture; hence, the negative correlation was in opposite of the predicted direction and a 2-tailed probability was calculated.

We found a small-to-moderate positive correlation between interest in American popular culture and interest in Japanese popular culture (r = .23, 2-tailed p = .000, N = 255). This was opposite of the predicted direction. The hypothesis can be tested further by examining interest (yes or no, coded 1 and 0) in specific forms of popular culture between the two cultures. For example, interest in American movies correlated positively with interest in Japanese movies (r = .13, 2-tailed p = .13, N = 133). The correlation between interest in American magazines and Japanese magazines was .14 (2-tailed p = .108, N = 133). The correlation between interest in American novels and interest in Japanese novels was .30 (2-tailed p = .000, N = 133). Interest in American television programs and interest in Japanese TV programs was .18 (2-tailed p = .042, N = 133). And, the correlation between interest in American music and interest in

Japanese music was .32 (2-tailed p = .000, N = 133). All these results are opposite of predicted direction.

Finally, a negative correlation was expected between interest in American popular culture and U.S. image, because a low score for U.S. image indicated a positive perception, whereas a high score for interest in American popular culture represented greater interest. The Pearson r was in the predicted direction (r = -.30, 1-tailed p = .000, N = 249).

After testing the bivariate hypotheses, we conducted multiple linear regressions in order to examine the impact of the TV exposure variable in the company of typical demographic variables which often are shown to be correlated with TV use; in this case, we chose gender (male = 1), age, and school attended as variables to be entered as prior predictors. In this way, we were able to assess the independent predictive ability of TV exposure, having controlled for the possible effects of these demographic variables. Another reason for the additional analyses was to sort out the many possible dependent variables and to provide a rationale, via factor analysis, for a streamlined examination of U.S. and Japanese popular culture, image, and relevant self/other perceptions.

This additional analysis began with an examination of a correlation matrix which included (1) personal interest in American popular culture, (2) a summary score concerning evaluation of American popular culture, (3) a summary score concerning evaluation of American image, (4) a measure of how the respondents evaluated others who sought information about American popular culture, (5) a summary score concerning the perception of others who maligned American popular culture, (6) a summary score concerning the evaluation of others who actively sought information about Japanese popular culture,(7) a summary score concerning the perception of others who maligned Japanese popular culture, and (8), personal interest in Japanese popular culture. Operationalization of concepts which used multiple items were based on summed scores from which Cronbach's standardized alpha reliabilities ranged from .69 to .80.

All these variables were candidates for dependent variable status in a multiple linear regression. Twenty-eight correlations were calculated for all possible pairs among these eight variables. Examination of the correlations revealed that 26 correlations were statistically significant. Among the two correlations which were not statistically significant, one was nearly so. The range of correlations was from r = .57 to r = .00, with an average correlation of .24, ignoring sign. This suggested that a factor analysis could be useful in condensing these variables according to factor structure. A 3-factor varimax solution which used eigenvalues of at least 1.0 led us to combine seven of the eight variables as follows: Factor 1, U.S. perceptions, items (1) through (4) above, accounting for 34.2% of the variance (eigenvalue, 2.73); Factor 2, Perceptions of others who malign the popular culture of either country or who actively seek information about Japanese popular culture, items (5) through (7) above. Factor 2 accounted for 19.5% of the variance (eigenvalue, 1.56). Factor 3 consisted of a single item, (8) above, accounting for 13.4% of the variance (eigenvalue, 1.07). Reliabilities of the computed factors were a Cronbach's standardized alpha of .75 for Factor 1 and .63 for Factor 2. Both showed near normal distributions.

Three multiple linear regressions specified this predictor entry order: gender, age, school, and then TV exposure. The three factors served as dependent variables (a separate analysis was run for each). For Factor 1, U.S. perceptions, gender accounted for almost no variance (r = .08; r square change = .006, not significant). Age accounted for 3% of the variance (multiple R = .19, significant). School attended accounted for almost no variance (multiple R = .20, R square change = .004, not significant), and TV exposure accounted for 1.6% of the variance (multiple R = .24, significant). Overall analysis of variance test F was 3.80, DF = 4, 256, p = .0051). The four predictors cumulatively accounted for 5.6% of the variance. Betas were -.12 for gender, -.23 for age, .05 for school attended, and .13 for TV exposure. For Factor 2, perception of others' positions regarding the countries' popular culture and actively seeking information about Japanese popular culture, gender, age and school accounted for slightly more than 1% of the variance. TV exposure accounted for 2.4% of the variance. Summary statistics include a multiple R of .19, a R square of 3.5%, and a F of 2.31, just barely missing statistical significance (p = .0586), DF = 4, 256). Beta scores were: gender, .08; age, .02; school attended, -.06 and TV exposure, -.16. The third regression named personal interest in Japanese popular culture as the dependent variable. Gender and age accounted for almost no variance, while school attended accounted for 1.7% of the variance. Exposure to TV was of no consequence. Overall, the multiple R was .13, the R square was 1.8%. The F was 1.17, DF = 4, 256, p = .32. Betas were: gender, -.01; age, .12; school attended, -.17 and TV exposure, -.02.

7. SUMMARY AND CONCLUSIONS

Descriptive results from this study indicate a high degree of personal interest in Japanese popular culture among Japanese adolescents, not surprisingly. Special interest was indicated in Japanese TV and rock music. However, the clear prominence of the U.S. as the next nation coming to mind after Japan also was noted. Japanese adolescents attributed this prominence to a perceived emphasis on the U.S. by the mass media. Most of the students expressed an interest in American popular culture, especially U.S. movies and rock music. But, they did not appear to be especially aware of the infiltration of American TV programs on Japanese TV, suggesting that TV exposure leading to awareness and interest in America and Americans was not particularly a conscious phenomenon. Japanese adolescents' motives for viewing TV reinforce the idea that any learning about foreign countries and peoples was incidental to gratifications sought involving entertainment, passing time, habitual behavior, etc., rather than conscious information seeking.

Results showed that TV exposure per se did not result in increased personal interest in American popular culture. Only slight support was found for a linkage between general TV exposure and decreased interest in Japanese popular culture, as expressed in negative feelings toward those who were perceived as actively seeking Japanese popular culture. We consistently found, contrary to hypothesis, that interest in American popular culture was related positively to interest in Japanese popular culture. And, not surprisingly, as interest in American popular culture increased, perception of U.S. image became more positive.

The results of separate multiple linear regressions, which sought to explain variance in three dependent variables (perceptions of U.S., perceptions of maligners of popular culture, and personal interest in Japanese popular culture) with three demographic variables (gender, age, and school) and TV exposure were disappointing. Very small proportions of variance accounted for were noted, with TV exposure figuring significantly into perceptions of U.S. and perceptions of popular culture maligners. Generally, increased TV exposure led to lessened interest in American popular culture and more negative perceptions of the U.S. Males tended to be more positive toward U.S. and Japanese popular culture than females. Older students also tended to be more positive toward U.S. and Japanese popular culture than younger students.

It appears from these data that adolescents who view Japanese TV are not likely to become avid seekers of American popular culture or to become Americanized in their behavior. Nor did viewing Japanese TV appear to have much impact on negative feelings toward Japanese popular culture. What little negative influence that was found pertained more to perceptions of others regarding popular culture than to self. Surprisingly, there appeared to be no conflict between personal interest in various forms of American popular culture and Japanese forms. In fact, interest in the popular culture of both countries consistently was positively correlated. Moreover, as interest in American popular culture increased, the favorable impression of the U.S. also increased. It appears that the possible negative impact of technological determinism as preached by Innis (1951) is not occurring in Japan, if these data are representative. There is no evidence in this study that Japanese adolescents are casting aside Japanese popular culture in favor of U.S. popular culture. In fact, the data suggest that interest (and possibly adoption) of both countries' popular culture occurs in tandem. It appears to be a case of "all or none" rather than "either-or." Therefore, it appears that what little influence TV exposure has on interest in and perceptions toward popular culture is more friend than foe, when interpreted in light of the macro concept of global village. Rather than being a disturber of the status quo, Japanese TV appears to celebrate it, or at least to neatly accommodate foreign intrusions and ideas.

In closing, we note the need for an improved understanding of interest in and perceptions of the popular culture of various origins. General TV exposure, in particular, is not an especially powerful predictor. Perhaps a more precise inquiry into programs offered, programs viewed, and into popular culture interest/perceptions which are tied to specific message content would yield stronger correlations. Along these lines, other media exposure should be included along with TV. Demographic predictors could be made more salient if the sample characteristics were broadened to include, for example, different generations, were there are wide gaps (Reischauer, 1977). On the intrapersonal level, we could examine the potential impact of values, conformity versus individualism, rebelliousness, etc. In addition to relatively static demographic predictors, we also suggest that future inquiries consider the more dynamic potential influences of group interactions and interpersonal communication.

In closing, Haglund's 1984 assessment, based on a review of prior scholarship, appears validated and worth repeating. She noted, "Indeed, this readiness to accept new ideas does not preclude loyalty to certain indigenous aspects such as Japanese food and traditional clothing. In fact, the very quality of receptiveness perhaps indicates a confidence in how secure, deep, and study certain values are, for new patterns are not perceived as threatening or corrosive to established mores" (p. 86).

8. FOOTNOTES

(1). A map which sorts countries into developed, developing, and least-developed confirms this generalization, with the exceptions of New Zealand and Australia, considered developed. See Canadian International Development Agency. (1988). A developing world. Hull, Quebec: Public Affairs Branch, CIDA. ISBN 0-662-56321-2.

9. REFERENCES

Canadian International Development Agency. (1988). A developing world. Hull, Quebec: Public Affairs Branch, CIDA. ISBN 0-662-56321-2.

Edmundson, M. (1984). McLuhan: It's all going according to Marshall's plan. Channels, 49-54.

Haglund, E. (1984). Japan: Cultural considerations. International Journal of Intercultural Relations, 8, 61-76.

Innis, H. (1951). The bias of communication. Toronto: University of Toronto Press.

Jacobs, N. (Ed.) (1961). Culture for the millions? Mass media in modern society. Boston: Beacon Press.

Lubis, M. (1986). Cultural integrity: Free and balanced information flow -- mutually exclusive terms or parts of the same thing? Media Asia, 13, 63-70.

MacBride, S. (Ed.) (1980). Many voices, one world: Communication and society Today and tomorrow. Paris: UNESCO.

Martin, L. J. (1986). Integrating international perspectives in the research methods course. In C. L. Ogan & B. J. Brownlee (Eds.), From parochialism to globalism: International perspectives on journalism education (pp. 59-68). Bloomington, IN.: International Division of the Association for Education in Journalism and Mass Communication.

Masuda, Y. (1980). The information society as post-industrial society. Tokyo: Institute for the Information Society

McLuhan, M. (1964). *Understanding media: The extensions of man*. New York: McGraw-Hill Company.

McQuail, D. (1987). *Mass communication theory*. London: Sage Publications.

Ochi, N. (1966, September). Television and local culture. *Chuo-koron*, pp. 197-203.

Reischauer, E. O. (1977). *The Japanese*. Cambridge, MA.: The Belknap Press of Harvard University Press.

Rosenberg, B. & White, D. M.(Eds.) (1971). *Mass culture revisited*. New York: Van Nostrand Reinhold Company.

Rosenberg, B. & White, D. M. (Eds.) (1957). *Mass culture: The popular arts in America*. New York: The Free Press.

Schramm, W. (1973). *Men, messages, and media: A look at human communication*. New York: Harper & Row, Publishers.

Servaes, J. (1989). *One world, multiple cultures: A new paradigm on communication for development*. Leuven, Belgium: Acco.

Tsujimura, A. (1987). Some characteristics of the Japanese way of communication. In D. L. Kincaid (Ed.). *Communication theory, Eastern and Western perspectives* (pp. 115-126). San Diego, CA.: Academic Press, Inc.

Whetmore, E. J. (1987). *MEDIAMERICA: Form, content, and consequences of mass commmunication*. Belmont, CA.: Wadsworth Publishing Company.

Yoshimoto, M. (1989). The postmodern and mass images in Japan. *Public Culture*, *1*, 8-25.

"I don't understand TV, but I know I want one"

Preliminary Report on the Social Impact of Television in Palau and the Marshall Islands

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1. ABSTRACT

This paper is a preliminary report on fieldwork done during the summer of 1990 on the social impact of television in two Micronesian countries. The paper presents a brief history of TV and video developments in Micronesia as well as some of the locally perceived socio-cultural changes and future implications of television/video viewing on society and culture in the Republic of the Marshall Islands and the Republic of Palau. Possible implication such findings may have for the broader telecommunications environment in the Pacific Islands are also discussed.

2. INTRODUCTION

While there have been a considerable number of studies concerned with the impact of television on social change and the development of values in the metropolitan societies of the Pacific Rim, very little research has been done on how television affects social change and the preservation of traditions in the developing Pacific Islands societies. Yet this is a question that is of critical concern to many people in the Pacific Islands. In this regard, Ratu Inoke Kubuabola, Fiji's Minister for Information, Broadcasting, Television & Telecommunications, expressed many Islanders' concerns during his opening address at the ABU/SPC sponsored *Pacific Regional TV Meeting* in 1989 when he stated that "the introduction of television services in the Pacific Islands will be, for most of us, a new industry. A development which I believe may have greater impact on the community than any other single development in our history" (ABU/SPC 1989: 46).

Whereas television and/or video is a relatively recent introduction into the telecommunications environment of a majority of Pacific Island nations, TV has been in the American affiliated Micronesian islands for about 20 years (1). However, television, in its various manifestations in Micronesia, is for the most part in a chaotic and unregulated state. It is the absence of comprehensive policies and controls in these countries (and indeed, throughout the Pacific Islands region) that has led to a proliferation of relatively uncontrolled TV systems. Although television could have a significant potential for community benefit, the absence of external program regulations makes achieving this potential extremely unlikely. Likewise, the lack of technical coordination and indigenous programing also gives impetus to the urgent need to understand television's social-cultural impact and to provide a basis from which to make intelligent and informed national policy. Since the introduction of television in Micronesia, little has been done to assess what impact this technology has had on Micronesian society, nor has any effort been made to address the policy issues brought about by television's introduction.

3. THE PROJECT & ITS SETTING

In the summer of 1990, with support from the Social Science Research Institute at the University of Hawaii at Manoa, a preliminary investigation was initiated in Majuro, capital of the Republic of the Marshall Islands, and Koror, capital of the Republic of Palau, to determine if there were actually any concerns about television's social impact on the part of the local population, and to ascertain what the perceived social impact of television was on each community. This was viewed as the first part of an estimated two-year project in conjunction with other Pacific area institutions participating in a pan-Pacific study of television's introduction and impact in the islands (2).

For the purposes of this study television was defined to include both broadcast and cable TV using satellite-delivered and/or taped-delayed programing as well as video tape rental for private home viewing. Working through the Palau Resource Institute in Koror, and the Alele Museum in Majuro, native speakers of the local languages were recruited as fieldworkers in both locations and trained in interviewing techniques using a comprehensive questionnaire and an open-ended interviewing instrument; both translated into the local languages. Questions were structured to measure both the content and displacement effects of television/video as well as assess perceived socio-cultural change and the anticipated future implications of television/video viewing on local society and cultural traditions.

The purpose of this paper is to report—in encapsulated form—some of the findings of this study. The paper will further discuss to what extent TV and/or video have contributed to the changing socio-cultural environment in the Marshall Islands and Palau (as far as can be measured using the study's methodology) and what implications these findings have on broadcast and communication policy in the broader telecommunications environment of the Pacific Islands (3).

4. TELEVISION'S DEVELOPMENT

4.1 TTPI

In 1946, the United States acquired administrative responsibility from the United Nations for the Trust Territory of the Pacific Islands (TTPI). The TTPI consisted of 2,000 small islands in three major archipelagoes (Marianas, Carolines, and Marshalls) that spanned an ocean area roughly the size of the continental United States but with a total land area of only 700 sq. miles (approximately 1,813 sq. km.). Of the 2,000 islands, only about 100 are inhabited, with a rapidly growing population of just under 200,000 people. Initially, the United States Navy governed these small islands from 1946 until 1951, when governance of the TTPI was turned over the US Department of the Interior (except for the islands of the Northern Mariana Islands—excluding Rota—which remained under Navy administration until 1962).

However, for the Micronesians of the TTPI, 1969 was *the* watershed year. In 1969, negotiations began between the Congress of Micronesia, as representatives of the people of the TTPI, and the United States on the future political status of the culturally diverse and scattered Micronesian islands. Since this time—and out of the framework of the American administration of the TTPI—four politically constituted micro-states have emerged: The Commonwealth of the Northern Mariana Islands (CNMI); and the Freely-Associated States of the Federated States of Micronesia (FSM), the Republic of the Marshall Islands (RMI), and the Republic of Palau (RP) (4).

The year 1969 also marked the beginning of television broadcasting in the Trust Territory with the first station initiating service on Saipan. The introduction of TV in Micronesia differed from that of radio broadcasting in that, radio was introduced as a government-owned and operated monopoly with enforced regulations and controls, and television came into the TTPI through the private sector with government assistance but little, if any, regulation or control (Tolstedt 1984).

During the early years of television's introduction into Micronesia, the only condition placed on operations by the High Commissioner of the TTPI was the requirement for a business operating permit from the local district legislative body where the TV service was to be located. The local district councils took little if any regulatory action to control the introduction of television services in their district, granting business operating permits on a perpetual term rather than a fixed-term renewable appointment; prompting one TTPI official to remark, "... [why] is this permit perpetual? We stand to lose control, if we ever had any" (Tolstedt 1984: 46).

Thus, from 1969 through mid-1980, several privately owned, for-profit television systems were introduced throughout the TTPI with little or no regulation: cable systems in Majuro, Ebeye, Palau, and Saipan; over-the-air scrambled broadcast systems in Pohnpei, Palau and Majuro; and open broadcast systems in Yap and Truk. Most of these systems have gone off-the-air for one reason or another; some due to mechanical failure and/or poor subscription levels, others to their poor quality and unreliable signal, and many found themselves facing strong competition from the growing number of video rental shops. However there are a few systems still in operation and a few new systems recently starting-up operations. The TV systems that have been in more or less continuous operation since they began are those in Saipan, Palau, and Majuro.

Although still concentrated in urban areas, television and video tape systems are spreading throughout Micronesia (and indeed, throughout the entire Pacific Islands region). Most of this expansion is in combination with the expansion of electrification into rural and/or outer island areas as well as the increasing availability and decreasing cost of satellite delivered programing and the ubiquity of the "mom-and-pop" video rental shops. Where TV or video systems are not present, it is more likely due to poor reception or lack of power rather than purely economic reasons.

4.2 PALAU

The Republic of Palau is comprised of more than two hundred islands (only nine of which are inhabited) which form an archipelago in the far south western corner of the North Pacific Ocean. It lies between 2 and 8 degrees north latitude and 131 and 135 degrees east longitude. Palau is relatively close to larger land masses (in comparison to other island nations), the nearest being the Philippines (550 miles to the west), Papua New Guinea (410 miles to the south), and Guam (815 miles to the northeast).

The economy of Palau is characterized by a small production base and a weak production capacity due primarily to limited natural resources, a lack of skilled manpower, and the absence of production-based economic development strategies. The predominant sector of the economy is the service sector which contributed 68 percent of the GDP in 1985, followed by trade at 13 percent. Within the service sector, the Government Administration dominates with a contribution of 38 percent of GDP. Agriculture and fishing are mainly subsistence activities and were estimated to comprise approximately 17 percent of GDP in 1985. Manufacturing's contribution to the GDP is almost negligible and consists mostly of small scale activities such as bakeries and handicraft production. Tourism is the potential growth sector of Palau's economy and with the construction of several first class hotels and the favorable diving and climatic conditions afforded by Palau, tourism is on the increase and expected to generate more employment opportunities in the future (Palau Office of Planning & Statistics 1987).

Data estimates from the 1990 census indicate that the population of Palau is just under 15,000 of which 56 percent are under the age of 24 years. The typical housing situation in Palau is one of extended families residing close together on a common family plot with an average household size of between 5-6 individuals and an annual family income of US$4,500 (Palau Office of Planning & Statistics 1990).

Two distinct languages are spoken in Palau, namely, Palauan and Sonsorolese-Tobian (spoken in the south-west islands). Palauan is most commonly spoken and is used as an official language along with English.

4.2.1 MEDIA HISTORY

From 1976 until April 1990, Palau only had one TV broadcasting system, WALU TV, owned and operated by Western Pacific Communications (5). WALU TV is a one channel, low powered broadcasting station covering the capital city of Koror and a few of the surrounding villages with a total population of approximately 9,500 people. Utilizing an over-the-air scrambled broadcast signal, revenue is generated through the monthly rental of decoding devices attached to the viewers television set. Prior to April 1989, monthly rental was US$20.00 per month, however this has decreased to US$15.00 per month with the initial connection fee of US$35.00 remaining unchanged. Programing predominantly consists of off-the-air taping of programs from US mainland television stations (complete with commercials) with approximately a two week delay (6). WALU TV broadcasts nine hours daily (3pm to midnight) with children's programs for the first hour (Sesame Street, Cartoons, etc.) and then regular commercial programming until sign-off.

In April 1990, Island Cable TV-Palau – a joint venture cable TV station between the Palau National Communication Corporation (PNCC) and the United Micronesian Development Association, Inc. (UMDA) – began operations in Airai State offering four channels of programing and one channel carrying the program guide and local advertisements. The service area of Island Cable TV-Palau was later extended into Koror State (June 1990) and its surrounding villages, however the absence of easements in some locations and cable shortages have slowed expansion beyond the city limits of Koror itself. Service fees consist of a one-time installation fee of US$25.00 and US$18.00 per month rental of the cable decoder and basic program services. Island Cable TV-Palau operates fourteen hours per day, offering as basic services off-the-air taped programs from three major US TV networks (ABC, CBS, NBC) and educational programing via the Public Broadcasting Service (PBS) on a one week delay from Honolulu, Hawaii. In August 1990, UMDA and PNCC installed a television satellite system in Palau to provide live CNN and ESPN programming as part of basic services for subscribers and by late-September, Island Cable TV-Palau had expanded their satellite services to include the "premium" movie channels, Disney Channel, Home Box Office and The Discovery Channel for an additional charge per premium channel. At present, there are plans to continue to expand the cable TV service area as well as expanding programming capacity to a total of twelve channels offering additional "premium" movie channels at an additional monthly subscription cost (Temengil 1990).

There are approximately fifteen video tape rental outlets in the greater Koror area offering a divers selection of action, horror, comedy, children and adult movies. The size of these video outlets range from Jason's Video with over 2,000 titles, to small village based "mom-and-pop" video shops with approximately 500 or less – usually pirated – video titles. The average cost of video tape rental is between US$1.75 and US$2.00 per video (the more popular and/or current titles commanding the higher price, Adult video rental is US$3.00 per video) on an over-night rental during the weekdays and a Monday return for weekend rentals. According to interviews with video shop owners and patrons, the average family's video rental is between 3-4 tapes per visit with the majority of people coming in for weekend rentals.

4.2.2 MEDIA POLICY

When the agreements for the future status of Palau are ratified, the High Commissioner will turn over the responsibility for television to Palau's government (see footnote 4). Under the terms of the Compact of Free Association Palau will have "full authority and responsibility to regulate (its) domestic and foreign communications" (Article 3, Section 131). Palau has opted to retain the FCC as a technical advisor and to represent their interests in the International Telecommunications Union (ITU). Thus, television remains unregulated and for the most part in the private sector.

However, the PNCC, formed by Palau's legislature in 1983 as a public corporation and charged with "[assuming] complete control, operation and maintenance of government owned communications . . . [and] to plan, develop and execute a national program for establishment of a national communications system" (Article 4, Sections 2-3), now finds itself in a position where it can exert some influence and control over television operations. As a public corporation, the PNCC regulatory powers extend only as far as government owned and operated communications facilities. Through its joint-venture with UMDA to provide television services through Island Cable TV-Palau, the framework now exists for the government to "regulate" television—at least partially—in the "public interest." This potential, as of yet, has not been operationalized.

4.3 MARSHALL ISLANDS

The Republic of the Marshall Islands consists of 29 atolls and 5 islands in the Central Pacific between 4 degrees and 14 degrees north latitude and 160 and 173 degrees east longitude. The atolls and islands are found in two almost parallel chains; the eastern *Ratak* group and the western *Ralik* group. The Republic is at a disadvantage in terms of its isolation from major population centers. The distance from Majuro, the capital, to Honolulu to the east is 2,136 miles, and to Tokyo in the north west is 2,300 miles.

Economic development in the Marshall Islands is subject to several constraints. As in the case of similar atoll countries, development is limited by small size, lack of on-shore resources, distances to overseas markets, problems of communications, and risks to natural disasters. Land, minerals, energy resources, fresh water, flora and fauna, are all limited in amount and variety. The major agricultural resource is 22,000 acres of coconut plantations of which only 16,000 acres are currently productive, yet coconut products accounts for 90 percent of exports (coconut oil and copra). It is the territorial waters (more than 750,000 sq. miles) of the Marshall Islands that provide abundant marine resources and the greatest potential for growth.

The modern sector, based almost exclusively in Majuro and Kwajalein, is sustained largely by the RMI Government and the US missile range on Kwajalein through their expenditures. Wages and salaries and other compensation paid to employees from these two sources are the major determinants of the GDP and contributed 51 percent in 1984. The share of Government wages and salaries alone was 23 percent with the Government employing about 37 percent of the modern sector labor force in 1983. The private component of the modern sector is small and its activities are confined to a limited range of distribution, service, and manufacturing activities (mostly handicrafts and copra processing, accounting for less than one percent of GDP).

The estimated 1990 population of the Marshall Islands is approximately 44,000 of which over 50 percent are under the age of 15 years. The typical housing situation in the Marshall Islands consists of extended families living together on common family land with an average household size of between 6-9 individuals and an average annual family income of US$1,307 (RMI Office of Planning & Statistics 1988). It should be noted that the average income in the urban areas is more than four times as high as in the rural areas when subsistence production is included.

The most commonly spoken language is Marshallese (*Kajin Majol*) and along with English, is use as an official language of government and business. Literacy levels in Marshallese are about 90 percent while English literacy is only about 25 percent (RMI Office of Planning & Statistics 1988).

4.3.1. MEDIA HISTORY

The Marshalls Broadcasting Company (MBC TV) took over the former operations of Pacific Communications Corporation (PCC) in 1979. PCC had maintained a cable television system in Majuro and Ebeye, off and on, from 1975 until storm surges in 1979 washed out much of the installed cable. Currently, MBC TV operates an open-air scrambled broadcast service that covers approximately half of Majuro atoll (population 16,018), with approximately 10-12 hours of programing per weekday and 14 hours per day on weekends. Daily programing consists of a range of off-the-air taped programs (sampling all three major US broadcasting networks) on a one week delay out of Kealakekua, Hawaii. The initial connection fee is quite steep at US$125.00 (refundable upon disconnection and return of decoder box), while rental of the decoder is US$20.00 per month. It is anticipated that MBC TV will soon abandon the break-down prone scrambled broadcast system and enter into a joint venture with UMDA to provide four channels of cable programing in a situation similar to that in Palau.

In early 1990, Alele Museum, through their small video production studio, took over the part-time "nonprofessional" broadcasting of educational programs from a private interest and launched Majuro Educational Television (METV) with approximately 10 hours of open broadcast of educational and local programs. Most of the programs shown are donated educational videos (e.g., English language learning programs from American Samoa) and/or off-the-air taped programs from PBS in Honolulu, Hawaii. However, approximately 2-3 hours per day (or 20-30% of programing) is produced "in-house" and consists of local news and events, story-telling, occasional public service announcements and Sunday church services; all using the local Marshallese language (*Kajin Majol*). METV also maintains a "bulletin board" with local announcements, the daily program schedule and local advertising an hour before and after regular programing as well as during program tape changes.

The seven video tape rental shops in Majuro conduct a brisk business. Luann's Video Rental and DAR Sales, with over 3,000 titles apiece (predominantly action films, comedy, and children's programs), are the largest and most centrally located. The smaller video shops, typically located outside of the main urban area, are "mom-and-pop" stores with an average of 500-700 titles. There are also at least three more video shops pending business licences. Video tape rental rates for all shops are US$2.00 per tape with next day return, including weekends, with an average family rental of 2-3 tapes per visit. Only two sites provide locally produced "special event" videos, the Marshall Islands High School Media Center and Alele Museum. Neither of these two charge for "checking-out" local videos.

4.3.2 MEDIA POLICY

As with Palau, the terms of the Compact of Free Association turned over to the Marshall Islands government the regulation of television as well as the responsibility for their domestic communications. The Marshall Islands also serves as its own notification authority in the ITU. However, television remains unregulated and, except for METV, entirely in the private sector. Currently, no framework exists through which the government of the Marshall Islands could easily incorporate regulatory policies for television. As it stands today, anyone wishing to start a television system in the Marshall Islands would only have to meet the requirement of obtaining a local business operating permit.

5. THE IMPACT OF TV

Wherever and whenever television has been introduced into a society, it has had an observable impact on that society. For

Palau and the Marshall Islands, the situation is no different. Yet, cause and effect cannot easily be demonstrated when one considers that television and video were introduced into Micronesian societies already undergoing critical social transformations resulting from rapid modernization under US administration. One is forced to ask how much of observable change is the result of television and how much is due to other social forces? As well, many effects of television are subtle and individually are barely noticeable, yet when taken together they add up to considerable changes in society. So what did this preliminary study reveal about the social impact of television in Palau and the Marshall Islands? The locations studied and questions asked, coupled with the complexity of the results, makes it difficult to provide a brief summary, yet what follows is an attempt to do just that.

5.1 MODES OF INFLUENCE

5.1.1 DISPLACEMENT EFFECTS

If no other factor can be illustrative of television's impact, the *displacement effect* – alteration in the use of time as well as what activities television replaces – are perhaps the most obvious examples of the often quoted statement that "the medium is the message" (McLuhan, 1964). Of the Palauans and Marshallese interviewed, 79% indicated that they were regular television and/or video viewers with most indicating that they watch almost every day and usually for several hours per day (Tables 1 & 2). The average viewing audience per TV/video set was between 4-6 family members and anywhere from 3-15 visitors (mostly young children). With such large viewing audiences engrossed in TV/video viewing almost every day; television has either out-right replaced, or significantly curtailed, such usual spare-time activities as gardening, fishing, story telling and visiting. In more than one instance, people stated that is was usual for men to go out fishing after they finished their regular jobs and for women to tend their gardens. Also, families frequently spent time in the evenings discussing the day's events and/or discussing local gossip and politics. But these activities were being done less often because people wanted to watch television instead. Likewise, Micronesian children traditionally spent most of their time after school outside; doing light chores or playing games. This is now seldom the case since children with access to television (and, increasingly more frequent, access to video games such as Nintendo!) now have a tendency to stay home (or go to a friend's home) and watch TV/video programs. This was seen as a mixed blessing. Television was perceived as good in that it helps re-enforce English taught to the children at school and it brings the family together during viewing times; even if they are not talking! However, with the large number of visitors TV/video owners are frequently having to contend with, the results are usually "strained" communal sharing values as well as hardship for the families visited who are expected to be "gracious hosts."

Television has likewise displaced other sources of media entertainment as well as news and/or information. According to a 1976-77 study of Pacific Islands commercial cinema (Takeuchi 1977), the Marshall Islands had eight theaters (on Majuro and Ebeye only) and Palau had three movie theaters all showing a variety of films. Prior to television's introduction all theaters conducted a brisk business with good attendance. However, only one year after television was introduced in the Marshall Islands, seven out of the eight movie theaters showed and estimated 50 percent drop in attendance. In Palau, just days after the first television broadcasts, theater operators were already complaining of declining attendance. Today, there are no commercial movie theaters in either location, all having long since gone out of business, although the US Army's Civil Action Teams in Palau occasionally have public screenings of films.

As an alternative source of news and information, television is starting to make an impact. In both Palau and the Marshall Islands radio is still the main source of news and information (Table 3), especially local news, and is probably the only truly *mass* medium in both locales since it uses both the local language and English in their broadcasts and is accessible to anyone who has a radio and batteries. The "coconut wireless" is still a popular mode of communication in both locations, but ranks well behind local radio broadcasts in Palau and the Marshalls as a source of local news and happenings. The print medium is facing serious competition from television in Palau where no indigenous press exists, and is likely to continue to loose ground now that live satellite delivered news (i.e., CNN) is available. The local press in the Marshall Islands (*The Marshall Islands Journal*) is quite active and is close behind the "coconut wireless" as a typical source of information (probably due to its mixed language content and the low English literacy rates in the Marshall Islands). However, television has begun to make inroads primarily as a provider of information on international events through the re-broadcast of satellite received Armed Forces Radio and Television newscasts in Majuro, and the re-broadcasts of network news programs (despite the delay) in Koror. It could be reasonably expected that as live satellite news programs become available over the local television systems in both countries, television's popularity as a primary source of information will increase.

5.1.2 CONTENT EFFECTS

By far the most popular types of television/video programs in both Koror and Majuro were "professional wrestling," the action oriented "American movies" and police/detective programs, with news, kung-fu, cartoons and serial dramas rounding out some of the more popular programs (Table 4). Quite frequently these programs were mentioned as being popular due to the ease with which non-speakers of English could understand the action and/or story-line. This brings up one of the more contentious aspects of television's impact, the *content effects*; what is shown on TV, the techniques with which it is portrayed, and how it affects viewers. If the premise that television, as a medium, has the ability to transmit an "unending stream" of attitudes, messages, and values is accepted; than it can be argued that television exerts some influence as an agent of socialization simultaneous with other agents of socialization (e.g., family, schools, peer groups, etc.) (Berry & Mitchell-Kernan 1982). Therefore, television becomes a powerful catalyst and arbiter of social change. When the primary source of television programming is external to a culture – as is the case with American programming on Micronesian television systems – then television's influence as an agent of socialization may run counter to the value systems internal to that society. Within Palau and the Marshall Islands, it was this potential aspect of television's impact on society that generated the most concern.

Whereas many respondents commented that television exposed their children to Standard English and served to reinforce classroom learning, it was also frequently sited that there was a disturbing lack of programing in their local language. The inappropriate nature of certain programs affronted local traditions and mores, the frequent portrayal of violence, and the "hard sell" of American advertising, were also viewed as major negative aspects of television. The sex, violence and "aggressive materialism" portrayed on the television and in video programs currently available in Palau and the Marshall Islands are being linked by respondents to behavioral changes within their societies; "We're getting more like Americans," was not an unusual response.

With regard to television advertising, the ads seen in Koror and Majuro have had demonstrable and direct effect of the kinds of products that are being imported (Smith 1976) in addition to shaping consumer demand and preference for advertised products. However, it is perhaps television's impact on knowledge structures and "flow of information" imbedded within traditional respect for the elderly that had many respondents worried. Since most older people in both societies do not speak English, the younger people must translate the televised stories for their grandparents. This reverses the traditional flow of information – instead of the old passing information on to the young, the communication flow is in the opposite direction. As a result of this, young people were seen to be discounting (or out-right ignoring) any information passed on from their elders. This disturbed many respondents and was interpreted as a serious break-down in the tradition of respecting elders and a possible catalyst for the potential loss of traditional knowledge due to neglect and its being replaced by mediated information.

5.2 SOCIAL, POLITICAL & POLICY IMPACT

Both the displacement and content effects of television have raised concerns in Palau and the Marshall Islands over TV and video having detrimental and irretrievable effects upon their respective cultures. There is a growing desire in both locations for increased local content and local language programing. Likewise, there is a strong desire to use television and video to record traditional myths and promote traditional crafts as well as to address local problems in a "creative way." Many also expressed a desire to see their respective governments enforce some form of regulation on both television and video. Suggested government actions included support for local programming and educational productions; the creation of a "review board" to monitor video shops and television programming, and the censor of "obscene" programs. Government officials in both Palau and the Marshall Islands, while seeing a role for government regulation through licensing, felt that educators, parents and community leaders should take an active role in monitoring television (As one official in Palau put it, "there is always the off button!"), and develop strategies to minimize the negative impact of television and video.

However, with the exception of Alele Museum's METV, there is very little local programing to address these concerns (outside of political announcements during election years, there is no local language programing in Palau), and even less governmental support for such endeavors. Neither are there any requirements placed upon current television service providers to include a local content in their programing. There is also very little being done to address the need to train individuals to produce local language programs. As it exists now, neither Palau nor the Marshall Islands are utilizing television's full potential. The responsibility to do this lies with the respective governments to first regulate in the interests of their peoples and, secondly, to assist in the development of locally trained television personnel who would be able to produce local language television programs.

6. IMPLICATIONS FOR THE "NEW TECHNOLOGIES"

The assessment of the impact of a technology like television is cruelly frustrating. As was mentioned earlier, it is often difficult to prove cause and effect between television and specific social change, particularly in developing countries where rapid change is already in progress. Therefore, any impact assessment of a technology, such as television, must recognize the open-ended nature of the task of assessing any impact—technology is embedded in an environment of very complex human beings and societies. Thus, this study took the perspective of viewing television as neither the cause nor effect of change, but rather that television functions as both an intensifier and catalyst of social change.

The same can be said for the "new communication technologies." According to a 1986 study of preferred futures in six Pacific Islands societies, Dator, *et al.*, found that many islanders expected "more and different kinds of technology" to be introduced before the next century, including; the electrification of rural areas, the expansion of the telephone system, the computerization of offices, satellite delivered television programing, home computers, "information gathering" technologies, and an agency to develop local television programing alternatives to foreign programs (Dator, *et al.* 1986). Whereas such technologies are seen as being the kind that assist people in doing their work and generally making life easier, their introduction should be carefully studied. There is no way one can say to a society that they cannot have the new technologies they desire. However, it is important to provide policy makers with information that will assist them in strengthening what people see as good in the introduction of new technologies, and limit what people see as bad, and the wisdom to know the difference.

7. END NOTES

(1) It is important to note that television existed in the Pacific Islands prior to its introduction in the TTPI. Television was introduced to American Samoa in 1964, five years earlier than the first station in Micronesia. Television was also introduced in the French Territories of New Caledonia and Tahiti in 1965.

(2) The cooperating individuals and institutions in the larger project are: Dr. Bruce Horsfield, University College of Southern Queensland; Dr. Nii-k Plange, University of the South Pacific; and Dr. Don Topping & Michael Ogden, University of Hawaii at Manoa.

(3) The full research report is expected out in May 1991 as a Working Paper of the Social Science Research Institute, University of Hawaii at Manoa.

(4) As of 1990, Palau is still a Trust Territory of the United States pending the resolution of conflicts between their nuclear-free constitution and the articles of free-association related to the United States' military interests and obligations. As such, Palau is still under the Communications Act of 1934 (and its subsequent revisions) and FCC broadcast rules and regulations with regard to television regulation.

(5) In 1976, two operating transmitters were licensed, one for a scrambled-broadcast signal (WALU TV) and another for a cable system. The cable system utilized primarily Japanese programs and was in operation for approximately two years before technical problems, and subsequent subscriber drop-off, caused it to close down.

(6) The Copyright Law Revision of 1976 remanded copyright restrictions and allowed for television systems in Micronesia to video tape off-the-air from US television stations. For more detail on this see, Thomas Brislin (1980), *Copyright and Cable TV in the Pacific: A Special Case* in PTC'80 Conference Proceedings.

8. REFERENCES

Asia-Pacific Broadcasting Union/South Pacific Commission (ABU/SPC) (1989, November). Report of the Pacific Regional TV Meeting. Suva, Fiji: ABU/SPC.

Berry, G. & Mitchell-Kernan, C. (1982). Television as a Socializing Force Within a Society of Mass Communication. In Berry, G. & C. Mitchell-Kernan (Ed.) Television and the Socialization of the Minority Child, Pp. 1-11. New York: Academic Press.

Brislin, T. (1980, January). Copyright and cable TV in the Pacific: A special case. In Wedemeyer, D. (Ed.), PTC'80 Conference Proceedings, Pp. IIh1-IIh9, Honolulu, HI: Pacific Telecommunications Council.

Compact of Free Association Act of 1985 (1986). Public Law 99-239, Washington, DC: US Government Printer.

Dator, J., Jones, C. & Moir, B. (1986). A Study of Preferred Futures for Telecommunications in Six Pacific Island Societies. Honolulu, HI: Pacific International Center for High Technology Research & the Social Science Research Institute, University of Hawaii.

McLuhan, M. (1964). Understanding Media: The Extensions of Man. New York: The New American Library, Inc.

Palau Office of Planning & Statistics (1987). 1986 Census of Population and Housing of the Republic of Palau (Belau). Koror, Palau: Office of Planning & Statistics.

Palau Office of Planning & Statistics (1990). Projected Mid-year Population 1990. Koror, Palau: Office of Planning & Statistics.

PNCC (1983, March). Articles of Incorporation of the Palau National Communications Corporation. (mimeo) Koror, Palau.

RMI Office of Planning & Statistics (1988). Marshall Islands Statistical Abstract. Majuro, RMI: Office of Planning & Statistics.

Smith, D. (1976). Cable TV in the Marshalls. Micronesian Reporter, 24, (3), 22-27.

Takeuchi, F. (1977). A Status Study of Commercial Cinema in the Pacific Islands. (MA Thesis) Honolulu, HI: University of Hawaii at Manoa.

Temengil, P. (1990, May 30). Personal Interview. Managing Director, Island Cable TV. Koror, Palau.

Tolstedt, M. (1984). Micronesian television and political change: Government control and regulation. Pacific Islands Communication Journal 13, (2), 41-51.

Table 1

Television & Video Viewership
(percentages)

	Regular Viewer	Occasional Viewer	Non-Viewer	No Response
Combined	79	1	17	3
Majuro	70	1	28	1
Koror	88	2	6	4

Table 2

Frequency of Watching Television/Video

Frequency	Majuro (%)	Koror (%)
Almost every day	28	28
3-5 day per week	5	7.5
1-2 day per week	6.5	10.5
When available	16.5	13
If spare time	6.5	14.5
Non-viewer	28	22
No response	10	5

Table 3

Primary Source of Information

	Combined (%)	Majuro (%)	Koror (%)
Local Radio	62.1	66.3	58
Neighbors/Friends	17.7	15.8	19.6
Local Newspaper	9.4	11.9	6.9*
Television	4.9	5	4.9
Foreign Print	4.9	–	9.8
Other	1	1	1

* *The Palau Tribune* is the Friday publication supplement of the *Pacific Daily News* out of Guam which reports local news and events in Palau on the first few pages.

Table 4

Most Popular Television/Video Programs

	Combined (%)	Majuro (%)	Koror (%)
Sports (Wrestling)	19.2	21.8	17.6
Amer. action films	14.8	18.8	10.8
Police/detective	8.9	9.9	7.8
Community programs	5.4	10.9	–
Kung-fu	4.4	3	5.9
Serial dramas	3.9	–	7.8
Gen. news	5.9	2	10.7
Educational	3	2	3.9
Japanese dramas	2.5	–	4.9
Cartoons	2	–	3.9
Other	7.5	2	8.8
No preference	22.2	29.7	14.7

CONTRASTING ROLES OF PUBLIC POLICY IN TELEWORK DEVELOPMENT IN THE UNITED STATES AND JAPAN

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1. ABSTRACT

Telework has been growing slowly but surely in both the United States and Japan. Most of this growth has been driven by private-sector efforts, while the role of government has been limited to date. Telework holds the potential to address societal concerns in both countries (e.g., traffic congestion, energy needs, and shrinking labor pools). There is an opportunity for governments in both countries to realize great benefits by advancing public policies which promote telework.

2. INTRODUCTION

Telework (or telecommuting) activity in the United States and Japan has been steadily increasing in the last three years. Despite the prevalence of the traditional office, it is becoming more accepted to do work in other locations. Research in the U.S. by LINK Resources, for example, shows a broadly-defined universe of over 34 million homeworkers in 1990, of which some 3.6 million are described as telecommuters.

The growth in telework in both countries is different in more ways than similar. Some of these differences reflect cultural, topographical, or urban and regional planning differences. For example, the most notable difference is that telework in Japan is almost entirely of the satellite office and neighborhood work center variety; U.S. telework means (almost exclusively) working at home, with only recent movement toward the remote-office concepts. It is the nature of these differences - and the different role of public policies that affect telework directly or indirectly - that is the focus of this paper.

3. RATIONALE FOR TELEWORK

The basic rationale for telework in both countries is essentially the same. Four common reasons are:

1. The need to address troublesome traffic and air quality problems;

2. The need to cope better with some labor supply problems in which certain regions (mostly urban areas) are lacking workers while other regions (mostly suburban or rural areas) are lacking jobs;

3. The need for public- and private-sector employers to control operating costs;

4. The need to cope with changes in employees' values and preferences that affect their choice of and attitudes toward their work.

In Japan, these four factors are compounded by a very intensive concentration of business and services in greater Tokyo, which is stretching transportation, housing, and other social services to the limit.

We believe that the future of telework's growth in both countries is likely to depend more heavily on these public policy issues than on the purely technical issues. Without a doubt, the growing range of telecommunications and computer resources makes telework more possible and more attractive, but we do not believe these technologies will be the primary determinants of its growth.

4. PUBLIC POLICY AREAS - OVERVIEW

We have identified six public policy areas that have an effect on telework; they are shown in the following chart. "Positive" means the policy area as it currently exists is supportive of the use/spread of telework, "negative" means it is contrary to the use/spread of telework, though not necessarily by intent, and "neutral" means there is no direct effect under current laws or policies.

SUMMARY OF EFFECTS ON TELEWORK OF SIX AREAS OF PUBLIC POLICY:

1. Tax and Zoning Regulations:

JAPAN	UNITED STATES
Neutral to Negative	Neutral to Negative

2. Air Quality and/or Transportation Demand Management Regulations:

JAPAN	UNITED STATES
Neutral to Negative	Neutral to Positive

3. Government Agencies as Model Telework Employers:

JAPAN	UNITED STATES
Neutral	Neutral to Positive

4. Government Sponsorship of Private-Sector Telework Programs:

JAPAN	UNITED STATES
Neutral to Positive	Neutral to Positive

5. Government Activities to Increase Awareness and Use of Telework:

JAPAN	UNITED STATES
Neutral	Neutral

6. Housing and Land Use Planning:

JAPAN	UNITED STATES
Neutral	Neutral

Before proceeding to a detailed analysis of each policy area, we want to point out that there has not yet been clear, consistent public policy support in both countries for more use of telework. Many existing policies, in fact, inadvertently work against the spread of telework. This is a problem because an innovative approach such as telework can benefit from government sanction if not support. However, telework is a relatively new concept and is just beginning to make its way into the federal vocabulary; if policy and support have been missing, it is not by intent.

Also, it is important to note that many of these public-policy areas are controlled at the level of the city or the state and prefecture, and not necessarily at the federal level. This may suggest a series of local, rather than national, activities; this might be a more expedient approach, but it also means that there might not be a coordinated national program. This is not necessarily a problem, however, because it can be difficult to develop a national approach that adequately recognizes and responds to regional differences.

Also, we believe that selective telework incentives could stimulate telework applications that have societal benefits. We recognize the need for both countries' governments to demonstrate fiscal responsibility, and therefore we are not advocating large-scale government spending or major changes in taxation approaches. However, we do believe that small, selective expenditures and tax law changes could have justifiable benefits, and will suggest these in the remainder of the paper.

4.1. TAX AND ZONING REGULATIONS

These regulations are at best neutral toward telework in both countries, and in some cases inadvertently work against it.

IN THE UNITED STATES, employers can deduct the costs of providing and maintaining office facilities from reportable income. The larger the office space, the higher the deduction. If there is any incentive to reduce office space needs, it comes from a desire to reduce operating expenses because of business conditions.

Also, there has been a series of changes in the regulations affecting the deductability of home-office expenses from personal income taxes. These changes were reactions to earlier rules that were perhaps too liberal, and to abuses that were common. The restrictive rules today generally do not provide a financial incentive for employees to work at home unless they are self-employed.

In the zoning area, there are some cities and states with rules against work at home. Some of these were written in response to abusive home employment practices in the garment and other industries from the early 1900's; others were written to maintain the residential character of neighborhoods by preventing businesses that would generate noise, smoke, or extra traffic. Neither of these conditions relate to telework, yet the rules remain. In reality, telework is "invisible" and in many cases is practiced in violation of these zoning rules that are often hard to enforce.

There are two possibilities for encouraging telework through zoning changes. The first is to stimulate the use of satellite or neighborhood office centers by promoting the "adaptive reuse" of vacant or outdated schools or small shopping malls. These are located in or close to residential areas, have multiple rooms or shops that could be used for teleworkers for various employers, and are otherwise non-productive assets. Using them for telework centers would reduce commuting and would generate real-estate tax revenues; the cost per square foot would almost always be less than downtown office space.

Second, there could be the same kind of incentive provided for telework as exists in some cities for child care. In San Francisco, for example, all new office buildings must include child care facilities for children of the tenants' employees; otherwise, the builder must pay into a fund for community child care resources. Zoning regulations could be linked to property taxes such that tenants in more densely populated office buildings would pay less tax in proportion to the number of teleworkers employed by those tenants but not commuting to the office.

IN JAPAN, the current corporate tax system neither discourages nor encourages any form of telework, with one exception. By allowing companies to carry some of the world's most expensive real estate at book (and not market) value, the tax system does indirectly make it easier for companies to stay in central, expensive sites.

Also, tax deductions for employee travel allowances were recently raised to 50,000 yen per month. While this means free travel between home and office for the company worker, it lessens the employee's desire for telework by completely removing direct financial cost from the commuting equation, and lets many commute by the faster bullet train so commuting time is reduced as well. An unintended outcome of this change is that it lets workers move even further from the office, since longer distances can now be covered in the same commuting time. This is another reason why high Tokyo land prices have been spreading into neighboring prefectures. Instead of extending tax breaks for employers, a change towards tax breaks for teleworking employees would be one way to put financial considerations back into the commuting equation, and stimulate teleworking in general.

Zoning regulations are generally very lax and neither prohibit nor encourage locations for satellite offices or even the ability to work at home. Urban areas are generally zoned into three categories: industrial/commercial, residential, and mixed industrial/commercial/residential; these are broad enough to allow satellite offices to be almost anywhere.

4.2. AIR QUALITY AND/OR TRANSPORTATION DEMAND MANAGEMENT

This is the most likely and most directly related policy area for telework influences, and the picture in both countries is quite different.

IN THE UNITED STATES, employers can deduct from reportable income the full cost of any parking facilities, reimbursed parking or even limousine service provided to employees. They can deduct only $15 per month of reimbursement for mass transit expense reimbursement, though legislation has been suggested to raise this limit. Some observers see this disparity as an indication of how well established the automobile has become, and how difficult it is to provide incentives for transportation alternatives.

There is a growing recognition that traffic congestion is becoming a national problem, and is no longer limited to well-known gridlock capitals such as New York and Los Angeles. There isn't enough concrete to solve congestion by construction alone, and the costs would be prohibitive. Mass transit is an alternative in far too few areas, and the costs of building new systems are not going to be accepted by an American population that shows signs of being at its limit with tax increases.

The most direct example of pro-telework policy is the so-called "Regulation 15" statute affecting five Southern California counties. This statute, issued by a regional air-quality board, requires employers to reduce the number of cars their employees use to come to work - most typically by car pooling, van pooling, and teleworking. Fines can be levied for non-compliance, though the quality of employer planning and "good-faith efforts" is evaluated in addition to the actual auto usage numbers alone. Similar statutes are in place or under consideration in other parts of California, Arizona, Colorado, and New Jersey.

There are some local examples where zoning is linked to transportation management, seen in some of the suburban or rural communities to which urban employers have been moving their offices. These communities welcome the employers (and the property taxes they will pay) but not without restrictions. Permission to build is sometimes linked to a requirement that the employer submit a plan for minimizing the effects of the added car traffic on the area - typically including car pool or van pool incentives and staggered work hours. Telework would be a natural addition to this list, but so far has not been emphasized.

Looking at the role of taxes on demand management, we note that the new Federal budget passed in the fall of 1990 included a five cent per gallon increase in the gasoline tax. Much higher increases (which could have motivated more employees to seek telework as an alternative to higher commuting expenses) were initially proposed but were defeated. To be sure, there were many other factors that affected the amount of that tax increase, but the fact remains that it is unlikely to stimulate much telework.

IN JAPAN, the road infrastructure is hopelessly inadequate. There just are not enough roads, most are too narrow, and at times are impassable due to frequent illegal parking.

Also, there is a clear distinction between moving goods and moving people. The great majority of Japanese commuters travel by train, while goods move by truck. The establishment of numerous satellite offices would not affect already negligible commuter-related automobile volumes greatly, but would significantly reduce commuting time for teleworkers travelling to them and for commuters who would still have to go to central-city locations.

As typified by the "kanban" or just-in-time system, the volume of delivery trucks is tremendous, not to mention the air pollution created by their diesel engines. Redirecting some of this traffic to satellite or neighborhood offices would reduce goods-related congestion and pollution and shorten delivery distances.

Like the zoning laws, air quality regulations in Japan are notoriously lax. There are none that promote telework even indirectly. The only local regulations related to traffic and air quality is a request by the Tokyo metropolitan government to limit the use of commercial vehicles on Wednesdays.

4.3. GOVERNMENT AGENCIES AS MODEL TELEWORK EMPLOYERS

This policy area addresses the opportunity to lead by example; there are a few encouraging signs in the U.S. but virtually none in Japan.

IN THE UNITED STATES, the Federal government has begun a telework pilot program that could include up to 2,000 workers in the early stage. There have been successful pilot programs in California (involving state government workers as well as numerous city and county governments) and in Hawaii and Arizona; others are being planned in Florida, Minnesota, Colorado, and Washington.

These programs are being established because these public-sector employers face the same problems as those in the private sector: the need to find and keep good workers, the need to economize on office space costs, and, in southern California, the need to comply with transportation-reduction statutes. However, these programs also have a curious effect on private-sector employers who are startled to learn that government bureaucracies are even piloting telework. The reaction is that, "if those tradition-bound agencies can do it, why can't we?" While it might be a negative kind of stimulus, it still works.

But these government programs are still the exception and not the rule, and they do not provide a universally accepted kind of leadership for programs elsewhere.

IN JAPAN, the situation is quite different. Generally speaking, the Japanese public service is able to attract high-quality employees, and is not looking for telework or other methods as recruitment or retention incentives.

There is often talk of the need to decentralize government offices, and of moving the Diet and large government agencies from Tokyo to another area. This move could help ease overcrowding in Tokyo and possibly reduce pressure on land prices. A resolution was adopted recently by both houses of parliament to support this move, but it does not have the force of law and only urges the government to "make efforts to realize the aim of this resolution."

Most important, the government is permeated by a strange reluctance to be first at anything. Rather than play the role of trend-setter or model employer, there is a feeling that government should be the last to reap the benefits of any new development like telework. It is highly unlikely that central government workers will be teleworking before the rest of the work force.

4.4. GOVERNMENT SPONSORSHIP OF PRIVATE-SECTOR TELEWORK

There are a few promising signs in both countries that the government can stimulate or be a catalyst for private-sector telework.

IN THE UNITED STATES, the pilot programs in the states of Hawaii, California and Washington include provisions for satellite offices to be used by government employees alone or jointly by private and public employees. The government is not funding these offices on its own, but is taking the important first step to get them established. Also, a bill passed in late 1990 in California will fund a private-sector telework project in a certain Southern California region, including "seed money" for a telework center.

These are important because there has been a stalemate in the development of telework centers. Private-sector employers want real-estate developers to build and equip these centers before committing to rent them. And, the developers want employers to commit to rent them before building them. Both sides wait for the other to make the first move, and, of course, no one does. When the government brings the development of these centers under the jurisdiction of a pilot program, it breaks this stalemate.

Another approach is for government to stimulate private-sector telework by providing tax credits to cover the cost of planning and starting pilot programs. Legislation for this purpose was introduced in California two years ago but has not been passed as yet. This may be a case where everyone agrees on the long-term benefits of telework, but no one in government is willing to give up the short-term tax revenue to fund it.

IN JAPAN, it is clearly the private sector that has been behind satellite office developments to date. The government has just begun to show interest in the broader issue of decentralization; both the Ministry for International Trade and Industry (MITI) and the Ministry for Post and Telecommunications (MPT) have allocated funds to two proposed private-sector projects. The Ministry of Construction is also looking into possible projects.

Rather than look for government sponsorship of private-sector programs, the private sector in Japan will be more likely to look for government to provide some kind of regulatory blessing for the telework movement as a whole. Given the leading role played by the Japanese corporate sector in establishing satellite offices, there is the possibility of some kind of public-private partnership; if so, the government is likely to be the junior partner. Local government at the prefectural or city level may provide more leadership, particularly in economically depressed or underpopulated areas.

4.5. GOVERNMENT ACTIVITIES TO INCREASE TELEWORK AWARENESS

Again, there have been some promising signs but much less than is needed:

IN THE UNITED STATES, virtually all of the pro-telework efforts by government have been in the states where pilot projects are underway or where local traffic or air quality regulations are in place: California, Washington, Hawaii, and Arizona. When we look at the rest of the country - and at the federal level - it is unfortunate that telework has not become more widely understood in the various agencies and become part of their vocabulary.

Even after Iraq's invasion of Kuwait and the resultant rise in gasoline prices, telework was not publicized as a way to reduce the dependence on imported oil. Americans heard about everything from monitoring their tire pressures to setting their thermostats lower, but telework was not mentioned. This is characteristic of the position taken by government in general when addressing air quality, energy conservation, and traffic congestion.

One notable exception was the two very favorable comments about telework made by President Bush in the spring of 1990, in the context of speeches about other topics. Those comments have been widely quoted, and clearly demonstrate the value of this kind of official sanction. The President committed no resources to telework, but the mere fact that he publicly expressed his awareness of and belief in the value of telework was extremely helpful.

IN JAPAN, there is little reason to believe that the government will do much to increase general public awareness of telework. The ideal situation would be to include telework in the long-term policy-making process; the reality is that the fragmented nature and short time horizon of policy making in Japan makes this unlikely. Consequently, it appears that the private sector will once again take the leadership in increasing awareness. The Satellite Office Association of Japan (SOAJ) is now being established as a wholly private initiative, and it may well develop into the primary source for information and guidance about telework - and be a source of policy advice and expertise to the government.

4.6. HOUSING AND LAND USE PLANNING

This last area is interesting because of the very different issues faced in both countries. To date, it has not been linked to telework and this is probably a serious oversight.

IN THE UNITED STATES, there are no national housing and land use policies. These are administered at the state or city level, with widely varying results.

While faced in both countries, the problem of mismatches between where jobs are and where people are living is perhaps more noticeable in the U.S. because of its larger size. The traditional regions with the highest concentrations of population and industry are changing, with a pronounced shift to the "Sun Belt" states in the Southeast and Southwest. Many of the New England, Middle Atlantic and Upper Midwest states have seen their populations decline in the last ten years, along with their factories and other employers.

A related problem is the less-developed regions in many states where local residents can't or won't relocate to where the jobs are. The result is high unemployment and a depressed local economy, adding to the burdens on already-pressed local governments.

These two scenarios combine to create an excellent opportunity for regional telework centers that create jobs by bringing them - electronically - from urban centers. Employers in the U.S. now export clerical and data-entry jobs to third-world countries in the Caribbean and in the Pacific Basin, and these jobs could just as well be "exported" to parts of the U.S. where the labor pool, housing and land exist. Small-scale pilot programs to do this are in being investigated in Michigan and Kentucky now, but there is no national, coordinated policy.

IN JAPAN, housing and land use are at the heart of the social fabric of the country. The lack of abundant land supply makes effective land use a priority. The shortage of reasonably-priced housing in urban areas - and the small size of most of these homes and apartments - means that the relatively easy, low-cost work-at-home form of telework is not a viable alternative.

Home costs are now out of reach for almost all new buyers in Tokyo; the cost of a small house or condominium now exceeds the lifetime earning capacity of the average office worker. Commutes are getting longer despite excellent train service, Tokyo is now struggling with its daily garbage load, and rural villages are shrinking in size as young people move to the cities to find better education and work opportunities. Thus, regional economies suffer at the hands of Tokyo's overwhelming pull.

Telework offers a way out of this kind of "social gridlock." It would let people live and work in cheaper, less crowded areas and would relieve pressure on overextended urban areas. The fact that certain segments of the Japanese business community are taking part in telework pilots means that there is hope that telework might be made available to more workers in the future. As has been noted earlier, however, this public-policy issue is being led by private-sector forces.

It must be pointed out, though, that telework in Japan is not widespread, and there are many companies that are not involved. The hope is that successful and expanding pilots will stimulate corporations to think about how they operate, how they are organized, and even how they evaluate their workers. In Japan, and in the United States, telework is a "lightning rod" that attracts attention about many underlying changes now underway.

5. CONCLUSION AND IMPLICATIONS FOR THE FUTURE

All in all, the evidence suggests that near-term telework growth will be led by private-sector actions, or perhaps some joint private-public partnerships in the case of the location and set-up of satellite offices. The private sector will continue to use telework for its own reasons; if the government chooses to support or provide some incentives for telework, that can only help increase the applications.

Even if government does choose to take a stronger public policy stance on telework, there are at least two potential obstacles:

1. THE FORCES AGAINST CHANGE: The entire automobile, highway and mass transit infrastructure has an awesome amount of power and political clout. No matter how beneficial it may be in the long term to build less roads and have shorter or fewer commutes, this can result in a short-term economic challenge for the advocates of the status quo.

2. THE ERA OF "DO MORE WITH LESS" GOVERNMENT: We know in both countries that we cannot expect government to solve all the problems and, in particular, to fund all the changes. The challenge to the creativity of telework planners is to find ways to use the policy-setting and coordinating role of government (together with the incentive value of the tax system) to orchestrate more telework growth without relying on a steady supply of government funds.

While it might seem an acceptable course of events to let the private sector take the lead, we believe the governments in both countries are missing many opportunities if they do not actively encourage telework. Urban congestion, air quality, and regional variations in labor demand vs. supply are all public policy issues that can be addressed in part by telework.

These are all issues that the national governments in both countries should be actively promoting, but as yet have not done so in any convincing manner. Selective, creative policy initiatives, which need not be costly, can help speed the broader use of telework and support steps taken by the private sector.

Telecommuting as a Strategic Management Tool

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1. ABSTRACT

This paper looks at the development and implementation of telecommuting at three San Francisco Bay Area companies with respect to its use as a strategic management tool. Included is a comparison of the origin and approach of the different telecommuting programs. In addition, we have reviewed current literature on key management issues and discussed how each organization has handled these issues for telecommuting.

2. INTRODUCTION

We first became interested in the subject of telecommuting in the Bay Area after the October 1989 earthquake sparked a renewed look at this work option among local companies. In fact, it was reported that a majority of managers who attended a post-earthquake emergency meeting of companies employing more than 200 people wanted a telecommuting option.(1) We decided to study how companies were using telecommuting but did not confine ourselves to limited applications such as disaster recovery. Instead, we looked at the broader issue of how telecommuting can help corporate management face current trends.

Our research included a review of the trends supporting remote work as well as current literature on telecommuting management. In addition, we conducted interviews with three Bay Area organizations to study how telecommuting was actually implemented. Our purpose was two-fold: To see the degree to which companies were using remote work as a strategic management tool, and to see how closely their programs followed the literature suggestions in key management areas.

3. CURRENT MANAGEMENT TRENDS

Corporate management currently faces several trends that present major challenges for all levels of management. One trend is work force demographic and value changes, including a shrinking labor pool, an increasing percentage of women in the work force, urban area expansion, and an emphasis on balanced lifestyles. A second trend is an increasing focus on the physical environment, including stricter controls on air quality and highway construction. Finally, global competition is mandating creative ways of improving corporate efficiency and productivity. Implementation of telecommuting programs can help managers accommodate these trends in their strategic planning.

4. OVERVIEW OF THE ORGANIZATIONS

We chose to research three Bay Area organizations which had relatively large, formal telecommuting programs. We selected a telecommunications company, a public agency, and a manufacturer. This section includes background information about the organizations and descriptions of individual approaches to telecommuting. General program results are also included.

4.1 TELECOMMUNICATIONS COMPANY

The telecommunications company we interviewed (hereafter referred to as "Company") provides telecommunications-related services within California. The Company was one of few organizations which had attempted to formalize telecommuting before the October 1989 earthquake.

Telecommuting at the Company is considered a flexible work option that benefits both the organization and the individual. It is a companywide option for management employees and includes an estimated 1,500 telecommuters who work either from their homes or from one of two satellite offices in northern and southern California. The Company employs approximately 17,000 managers and seems bureaucratic in structure. In general, this type of structure may tend to limit employee autonomy and information-sharing.

The Company's current telecommuting policy evolved out of an interest in participating in reducing traffic congestion at the 1984 Summer Olympics in Los Angeles, California. The success of the commuting alternative for the Olympics prompted the Company to implement an 18-month telecommuting pilot program for 100 volunteer workers. Hundreds more became involved and soon informal telecommuting arrangements spread throughout the company. The Company recognized that an overall policy was needed but it was not until November 1989, after the October earthquake, that management established formalized telecommuting policies and guidelines which are still in effect today.

Telecommuting at the Company exists to satisfy the needs of the company and the employee and can be used for various reasons. It can relieve short-term problems, such as emergency situations and occasional childcare or eldercare conflicts. The telecommuter and the supervisor must sign an agreement detailing the specific arrangement and joint responsibilities. It is our opinion that the agreement is consistent with the Company's corporate culture and bureaucratic structure.

The management at the Company expects telecommuting to expand but it will take some time for people to become comfortable with it and believes that telecommuting will never be appropriate for all jobs due to the nature of the work performed. The Company plans to evaluate the telecommuting option for those jobs and people it benefits the most but has specified no evaluation date.

4.2 AGENCY

The public agency we researched (hereafter referred to as "Agency") was one of 14 government entities that participated in a 12-month pilot program to study telecommuting as a work option. The program, which ended January 1990, had a total of 230 participants, 60 of whom worked at the Agency. The pilot was managed by a parent government organization (hereafter referred to as the "Parent").

The Parent rationale for implementing the pilot program was that the benefits of the program were believed to be greater than its execution costs. The benefits were strategic in nature and included improving air quality and traffic congestion, dependent care, natural disaster planning, productivity, and employee retention. In contrast, the Agency did not view the telecommuting option with the same strategic benefits in mind. Instead, middle managers "sold" it to Agency management as a work option which would lower costs and improve productivity. The long-term benefits envisioned by the Parent, therefore, were not key to the implementation within the Agency.

The results of the pilot within the Agency were favorable with respect to costs and productivity. Telecommuters had fewer absences and used less office space (many shared offices). Productivity was thought to be higher, although no quantitative study was done. Resistance from management, however, remains a roadblock in continuing telecommuting as a work option at the Agency. Some line managers felt managing telecommuters took extra time and effort. Two of the eight division heads did not want telecommuting to continue in their divisions.

The collective results for all the agencies had a longer range orientation and a wider scope than the Agency results. Although the final evaluation is not yet available, the preliminary report issued June 1989 described several promising effects. Telecommuters were more effective than non-telecommuters and employee retention was better. Telecommuting seemed to lower stress levels and significantly decrease automobile use. The report also stated that top-down support is vital to the success of telecommuting.

The contrast in the Parent design for the pilot and the evolution of telecommuting at the Agency level may be a function of the large scale of the program. The Parent organization was responsible for developing and administering the program with the assistance of outside consultants. The size and complexity of the program may have removed Agency management from the decision-making process.

Although extensive reports and training materials were provided by the Parent to the Agency, the telecommuting goals of the two groups remained different. The Agency management seemed to see telecommuting as a potentially cost-saving work option, unrelated to the strategic concerns of the Parent.

4.3 MANUFACTURER

The last organization we interviewed was a world-wide manufacturer (hereafter, referred to as "Manufacturer") whose northern California home office is staffed by approximately 350 employees. The company is known for its progressive and non-bureaucratic management style.

A six-month pilot program began at the home office in January 1990 and ended in July 1990. The rationale for the telecommuting pilot was quite different than that of either the Company or Agency. Rather than an accommodation to employees, the Manufacturer saw telecommuting as a strategic imperative which was necessary for the future competitiveness of the organization. Senior management considered telecommuting an inevitable result of demographic changes in the work force and lower technology costs. The pilot program was thus a necessary step for the Manufacturer to keep abreast of changing work options.

The management commitment to researching telecommuting was evident in the origin and implementation of the pilot. Upper level managers in information resources saw a need for telecommuting and proposed a pilot program to an Executive Management Committee. The senior managers in the committee approved the pilot because of its consistency with the organization's goals and mission. The commitment of the Manufacturer to personal accountability, trust, and open communications, which are cornerstones of the corporate mission, was evident in the pilot program. Managers and telecommuters were both given tremendous flexibility in implementing the telecommuting work option.

General results showed there was no reason to keep the Manufacturer from recommending telecommuting on a companywide basis. The reaction of the telecommuters and managers was highly favorable. Findings indicated that though the period of adjustment varied for each participant, the key to successful telecommuting was internalizing the changes in the new work environment. The Manufacturer found that the critical issue for telecommuting seemed to be work scheduling, not job type.

5. MANAGEMENT ISSUES

We researched several key issues for managers of telecommuters, including: (1) selection of employees, (2) work scheduling, (3) performance measurement, (4) communication structures, (5) employee workspace, (6) cost analysis, and (7) organizational issues. We chose to discuss the first three listed above because these demonstrate clear differences between the organizations. Also included in our discussion are descriptions of how each organization handled these management issues.

5.1 SELECTION OF EMPLOYEES

5.1.1 LITERATURE REVIEW

The literature regarding the selection of employees includes descriptions of desirable personal qualities of the telecommuting employees, as well as criteria for choosing types of jobs for remote work. The ability to accept and deal with social isolation, and strong self-motivation are considered important qualities. Those with specialized skills or proven loyalty to the company are also thought to be good candidates for telecommuting, as are longer-term workers who better understand the organization and have previously established relationship with co-workers.

Other qualities thought to be important by telecommuting experts include a high need for autonomy and a low need for affiliation and social support. People with high needs for power and dominance generally do not do well working at home.(2) It is also thought that certain jobs do not lend themselves to remote work, including those which necessitate customer contact, team projects requiring close contact, and those requiring frequent feedback and discussion.(3) Technical and independent work is also considered preferable to other types of work.

5.1.2 COMPANY

The Company also included in its guidelines personal characteristic recommendations consistent with the literature, including: A proven ability to perform the work, high degree of job knowledge, self-motivation, self-discipline, above-average management skills and an ability to work alone. Desirable qualities for managers of telecommuters included: Having an open and positive attitude toward the new work option, mutual trust and respect of the telecommuter, above-average organizational skills, and an ability to establish clear objectives and measurements.

At the Company, telecommuters were required to be managers. Non-management employees, who were members of a union, could not telecommute due to legal issues associated with the union contract. According to Company guidelines, jobs that have clearly defined goals and require low face-to-face communication and little supervision are most appropriate for telecommuting.

Of the three organizations studied, the Company had the most detailed and restrictive guidelines for choice of telecommuters. The large size and structure of the Company may be one reason for this. Policies and guidelines may tend to replace trust in managers' abilities to successfully choose telecommuters. In fact, some organizations might view these guidelines as necessary conditions of employment, rather than personal characteristics lending themselves to telecommuting. A second reason for the detailed policies may be a fear of litigation, which seems to be a major factor in much of the Company's activity related to telecommuting, including the written agreement required for telecommuters and the exclusion of union workers from remote work.

5.1.3 AGENCY

At the Agency, selection of telecommuters followed the suggestions in the literature fairly closely. The Parent organization's written guidelines recommended that four personal qualities be present in telecommuting employees, including: (1) a history of reliable and responsible discharge of work duties, (2) full understanding of the operations of his/her agency, (3) the trust of his/her manager, (4) an ability to establish priorities and manage his/her time. The amount of information processing done by the employee was central in choosing the types of jobs suitable for telecommuting. Jobs which required researching, processing, and dispensing of information were considered more "telecommutable" than those with larger service components.

The Agency followed the guidelines supplied by the Parent quite closely in choosing telecommuters. Qualities sought included independence, experience, and self-motivation. Positions requiring writing and analysis were chosen; those that were service-related or place-dependent were generally excluded.

The close relationship between the available literature on telecommuting and the actual guidelines established by the Parent organization may be partly due to the use of an outside consulting group for the establishment of the pilot. Also, the wide scope of the pilot, which involved several different agencies and departments, may have made detailed guidelines necessary for control of the pilot at the Parent level.

5.1.4 MANUFACTURER

The Manufacturer had the least restrictive guidelines for employee selection of all the organizations. In fact, there were only two requirements for telecommuters: Employees must have worked for the Manufacturer for at least six months and had to be rated as at least "average performers." Otherwise, the choice of telecommuters was left up to individual managers, indicative of the Manufacturer's focus on autonomy and individual responsibility. Although certain managers may have used criteria contained in the literature to choose telecommuters, no specific recommendations along these lines were provided by the Manufacturer.

5.2 SCHEDULING

5.2.1 LITERATURE REVIEW

The literature available does not provide recommendations for specific telecommuting schedules. The consensus seems to be, however, that working part-time in the office combined with part-time off-site is the best work design. This allows employees to work on projects uninterrupted off-site while still allowing for in-person interaction with co-workers.

5.2.2 COMPANY

At the Company, telecommuters were required to work in the main office at least once per week. Otherwise, scheduling was left up to individual managers.

5.2.3 AGENCY

The pilot program also required telecommuters to work in the office part-time. The guidelines at the Parent level required telecommuters to spend a minimum of one day per week in the main office. Otherwise, work schedules that were "consistent with the requirements of the employee's work group" could be approved by managers. At the Agency level, schedules were more rigid. Telecommuters could work off-site no more than two days per week, and telecommute days could not be consecutive.

5.2.4 MANUFACTURER

Like the first two organizations, the Manufacturer required telecommuters to work in the office part-time. Guidelines for scheduling were that no more than two days per week should be spent off-site and that those days should be scheduled in advance. It soon became apparent, however, that pre-scheduling was not working for more dynamic jobs. The Manufacturer then changed the guidelines to require employees to simply keep co-workers informed of telecommute schedules.

5.3 PERFORMANCE MEASUREMENT

5.3.1 LITERATURE REVIEW

The literature on the measurement of work performance emphasizes the need for managers of telecommuters to track productivity and look for sustained productivity gains once participants (telecommuters, co-workers, managers, and family) are comfortable with remote work. Telecommuting advocates suggest that managers establish a solid measurement system which takes into account all aspects of the job but does not overmeasure quantitatively. When work output is not quantifiable, the manager and the telecommuter should use subjective variables, such as improvement in concentration due to less interruptions. It is important for managers to understand that results, quality and timeliness are inseparable indicators of output and should be examined collectively when evaluating a worker's performance.(4)

It is believed that measurement of telecommuter work performance will vary according to individual situations. When an individual begins to telecommute, a period of adjustment is required before work performance can be evaluated. The excitement and willingness of participants may initially lead to high productivity gains due to what is known as the Hawthorne Effect in which they want telecommuting to succeed.(5)

In contrast, some may experience a decrease in productivity during this transition as telecommuters work out for themselves the most effective blend of personal and work time. It is essential for managers to understand these effects and allow time for people to adjust to telecommuting. Regular feedback from supervisors helps to ensure that the measurement is appropriate for the current needs of the organization.

5.3.2 COMPANY

The Company's guidelines for measuring telecommuter performance paralleled the literature with respect to solid measurement systems. Although flexibility was maintained by allowing telecommuters and supervisors to make cooperative arrangements on a case-by-case basis, emphasis was placed on performance results. Timekeeping and reporting mechanisms were required to measure the telecommuter's performance. After project tasks and deadlines were defined, telecommuters were required to participate in regular sessions to assess their performance and success of the project. Though work performance varied according to each work situation, Company policies mandated deliverables and timetables. In addition, work commitments were enforced with written agreements signed by telecommuters and supervisors. These actions seem consistent with our earlier observation about the bureaucratic structure of the Company.

5.3.3 AGENCY

In general, the Agency performance measurement was more flexible than the suggestions found in the literature. The Agency had no standard formal performance measurement. Supervisors were responsible for choosing methods of measuring telecommuters' work.

5.3.4 MANUFACTURER

The Manufacturer, like the Agency, set less rigid performance measurement standards than recommended by the literature. Standards were established by telecommuters and managers, some of whom set up more structured job goals than others. There was no "across-the-board" policy or written agreement imposed upon the telecommuting participants. This method of performance evaluation is based on trusting work relationships which we believe to be indicative of the Manufacturer's commitment to employee autonomy.

6. CONCLUSION

In looking at the focus of the telecommuting programs at the three organizations, differences in strategy emerge. At the Company, telecommuting is primarily an accommodation to employees which happens also to benefit the Company. The reasons for implementing telecommuting do not seem strategic, that is, directly related to positioning the Company for the future, and can thus be termed "reactive." Within the government program, the Parent organization has clear strategic goals for telecommuting. The Agency, however, does not seem to have incorporated the same goals in implementing telecommuting and instead sees remote work as a means of achieving narrower operational goals. Lastly, the Manufacturer seems to have the most proactive approach. Here, telecommuting is seen as a strategic imperative in preparing the company for the future.

It is our opinion that setting proactive goals for a telecommuting program is not a necessary condition for successful telecommuting. In fact, the achievement of even limited operational goals such as cost reduction can be seen as a success brought about by telecommuting. The effectiveness of telecommuting as a management tool, however, can be enhanced by a more strategic approach toward its use. Organizations in which all levels of management see telecommuting as a way to achieve long term goals will likely receive a wider range of benefits from its implementation.

7. REFERENCES

(1) Savage, J. A. "Quake Jolts New Life into Telecommuter Idea," ComputerWorld, October 30, 1989.

(2) Hall, Douglas T., "Telecommuting and the Management of Work-Home Boundaries," Working Paper, Boston University, August 1989.

(3) Atkinson, William, "Home/Work," Personnel Journal, November 1985.

(4) Gordon, Gil E. and Kelly, Marcia M., Telecommuting: How to Make It Work For You and Your Company, Prentice-Hall, Inc., New Jersey, 1986.

(5) Mescon, M.H., Albert, M., & Khedouri, F., Management, Harper & Row, Publishers, New York, 1985.

Introducing Telework to Japan - Today & Tommorow

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1. ABSTRACT

In recent years, various problems have arisen in Japan resulting from industries and people converging on one area, specifically Tokyo, the nation's capital. In particular, the problems such as rising land prices and traffic jams in Tokyo and its vicinity are serious and never ending.

Meanwhile, thanks to the recent remarkable progress in information networks represented by the digital network expanding nation-wide, communications among various domestic areas as well as overseas are becoming easy. At the same time, personal computers and word processors are becoming extremely popular, and their performance has improved. Against this background, Japan's labour environment has been improving remarkably.

However, there are still various problems related to those resulting from the ongoing convergence on Tokyo and the aging of Japan's society, and those resulting from facing various changes in the labour force and labour structure such as Women's advancement in society, changing values and young laborers' attitudes towards labour.

Under these circumstances, we studied why Japan needs telework and clarified the issues. As one measure, we introduce telework which has been tested and introduced in corporations all over Japan. More precisely, we introduce actual examples from the communications departments of Fujitsu.

We also present ideas on how Japan's telework will evolve in the future, how one would carry out such work, how to use information communication equipment, and how to evaluate.

2. WHY IS TELEWORK NECESSARY?

2.1 DETERIORATING URBAN ENVIRONMENT

In our country most service functions including information functions centre around large cities, and one area in particular, Tokyo. The reasons for this are because the head offices for each function are centred in Tokyo, and as a result their related offices are centred in its vicinity, and it is also a base for dispatching mass media and culture.

This resulted in increased employment opportunities of various kinds, causing the following urban problems:

- rising land prices
- traffic jams, lack of parking space
- long distance commuting
- air pollution
- weak to disaster

2.2 CHANGES IN THE LABOUR FORCE

Lately the labour structure is starting to show some changes because of a shortage of software engineers in the information communication industry. This resulted from increased employment opportunities in non-manufacturing, such as in the expanding service industries in our country, and increased labour demand for OA equipment engineers due to advanced technology. More serious changes are an aging labour force due to the advancement of woman in labour, a low birth rate, and above average life span. Under these circumstances, and along with rapid advancements in the information communication industry, the problems are becoming more conspicuous related to the shortage of software engineers, of young laborers, and a stable labour force.

The following summarizes changes in the labour force:

- aging labour force:
  shortage of young laborers
- Women's participation in labour:
  continuing to work after marriage and giving birth
- changing values:
  giving more serious consideration to family life, values shifting from organizations to individuals
- the "U-turn" phenomenon:
  returning from large cities to birth places
- increasing assignments of people without the accompaniment of their families:

2.3 REQUIREMENTS FOR TELEWORK

We mentioned the present social problems such as Japan's deteriorating urban environment and changes in the labour force under sections 2.1 and 2.2. As one approach to solving these problems, we think the introduction of telework is essential.

The following are the present needs to be met by introducing telework.

(1) Social needs
- secure manpower with high productivity
- solve housing problems (lack of housing), commuting problems
- initiate local activities

(2) Individual needs
- carry out high level jobs freely in beneficial environments
- maintain families in small family constitutions

2.4 ADVANCEMENTS IN INFORMATION COMMUNICATION TECHNOLOGY

The recent progress in information communication technology is remarkable in the areas of better facilitated information communication networks and advanced OA equipment. Progress in the following information communication technologies has been particularly remarkable.

- expanded digital network
- higher function, higher performance, portability of OA equipment such as personal computers and word processors.
- expansion in electronic mail
- improved human interface
- expanded ISDN network

2.5 WHAT KIND OF TELEWORK IS REQUIRED?

Taking into consideration the telework requirements which represent solutions to the problems mentioned above, and the advancements in information communication technology, the following are the types of telework that Japan requires:

(1) Satellite office types

- With the objective of living close to work, satellite offices are created in the suburbs of large cities.
  women labour force, employment of seniors,
  eliminatiing long distance commuting
  establishing communication networks with head offices

- With the objective of securing higher productivity and excellent manpower, satellite offices are created in local areas.
  securing excellent local manpower
  establishing a high speed digital communication network between the nation's capital and local cities

- With the objective of initiating local activities, satellite offices are created in local areas.
  promoting local industries
  promote academic-industrial collaboration.

(2) Resort office type (private business type)

- In pursuit of the relaxed, rich life, resort offices are created in resort areas.
  providing environments for intensive work but in a relaxed mood
  An individual uses a set of information communication equipment.

3. JAPAN'S TELEWORK TRENDS

Companies have been trying various approaches to telework over the past several years. The following are some examples:

(Satellite office)
"Shiki Satellite Office" which was created by Fuji Xerox and four other companies with the objective of enabling living close to work.
- Installing and utilizing workstations, facsimile machines, network facilities

(Resort office)
Experiment of the "Kumamoto Resort Office" which was created by Kumamoto Prefecture and several companies in Kyushu.
- Installing and utilizing up-to-date equipment such as workstations and facsimile machines in cottages.

In addition, communication equipment, construction, and steel companies are implementing experiments and introducing satellite offices.

(Example of Fujitsu's Communication Departments)

Fujitsu is creating satellite offices in many locations in Japan with the objectives of securing manpower with high productivity and local engineers' living close to work. We are actively involved with achievement of the goal where "we work intensively in our own time at the same level of work as in central cities, in an environment away from the centre, in positive living and working conditions".

We are also actively involved with achieving work style goals [Excellent-Work-Way] to cope with newly emerging cultures such as easy-to-work-in office environments, richer individual life, localization and so on.(Figure 3.1)

(Concept of excellent-work-way)
- Flex-working
  Enalle workers to exchange information with anybody anywhere and anytime, free from the traditional time and space constraints.

- Smoother communications
  Using the media of electronic documents and messages, interfaces between engineers, or developers and administrators are made possible beyond time and place.

- Document innovation
  Design know-how which used to be for paper-based documents and belong to particular individuals is to be expressed as information for engineers and stored in databases for easy control.

The environment and work involved is as follows:

Environment: Central areas of local cities where activities based on local culture and life are possible.

Communication network: High speed digital communication, electronic mail, electronic conferencing facilities

Information equipment: personal computers, workstations, medium-sized computers, facsimile machines

Job description: Development of communications software and firmware

Engineers: People from nearby area offices

- Office environment
  - free access
  - one terminal per person
  - Office LAN
  - print server, file server, filing system
  - local host computer
  - refreshment room, review room
  - background music facility
  - smoking room, first aid room
- Support functions
  - network and tools for remote use of the mainframe host computer from large city centres.
  - network and tools for debugging remotely using software debuggers from large city centres.
  - using electronic mail (minutes, event information etc.)
  - establishing and using software development standards
  - development of control database
  - software engineer education support system
  - quality control, evaluation system
  - introduction of flex-time

4. SUGGESTION FOR FUTURE TELEWORK

In Japan, the Ministry of Posts and Telecommunications, local public organizations and companies will promote teleworking even more in the future.

In that case, the main telework type will be (a) creating satellite offices in the suburbs of large cities, (b) creating satellite offices in local cities, (c) locating head offices in local areas and creating satellite offices in Tokyo, (d) creating offices in natural environment resort areas.

The following are our suggestions as to how telework will evolve and be promoted in the future. These are based particularly on the premise of intellectual production areas such as software development work.

4.1 EARLY DEVELOPMENT OF BASIC INFORMATION COMMUNICATION TECHNOLOGY

(1) Building practical communication networks
- Providing in-expensive communication networks
- Network technology and OA equipment which facilitate quick response
  (Upgrading high speed networking, computing power)
- Terminals with human interfaces which allow easy comprehension and operation
- Database technology and network technology which allow shared use of information
- Providing B- ISDN
- Enhancing electronic mail services (expanding from characters to graphics)
- Support teams which periodically check Local offices

4.2 CREATING ENVIRONMENTS FOR HIGHER PRODUCTIVITY

The objective for the fundamental concept is that "the same or higher output from activities can be expected as that of the central area".

- An office environment is required which allows implementation of flexible types of work efficiently such as systems engineers' and consultants' work as well as co-operative work such as programming and data entry.
- Building a creative office environment
  Intelligent building facilities and the most up-to-date information communication equipment are required. At the same time flexibility to accommodate advancements in facilities/equipment is required.
- Flexible working conditions
  Introduction of flex-time and project team methods
- Shared access to information
  A system is required which enables free access to databases of know-how and new technology from both central and satellite offices.
- An institution is required which will allow engineers to brush up their skills periodically.

4.3 METHODS OF EVALUATING PRODUCTIVITY AND QUALITY

A visible mechanism which enables administration departments access to activities and output data is required so that the centre can easily collect and evaluate the work data from satellite offices.

- In environments where jobs are done via personal computers and workstations, tools are required to collect data automatically on the progress and outcome of work.
- Evaluation data requires visual display system.

4.4 ENHANCING AND PROMOTING RELATIONSHIPS WITH LOCAL INDUSTRIES

- Mutual research with local universities, promote academic-industrial collaboration
- Absorbing various needs arising in local areas, and customer support
- Co-operation to promote local culture
- Digging latent labour force
- Effective use of locally developed software

5. CONCLUSION

In the near future, Japan's telework will move from the experimental stage to an introduction period.

In order to promote and expand telework, effective use of time and space in satellite offices must be considered. Global and intelligent networks which eliminate the sense of the centre and the local must be built as soon as possible, and support systems for their operation are also essential.

Our goals are to give more serious attention to individual freedom, to create an environment with no restrictions, to use latent technological know-how and the skills of seniors and disabled persons effectively, to make better use of manpower such as presently increasing part-time work, and ultimately create an environment where tremendous power combinations can be shown.

6. REFFERENCES

[1] K.Nakamura, "TRAINING AND EDUCATION IN THE TELECOMMUNICATION FIELD"
PTC'86 Proceedings, P.318-P.323, 1986

[2] R.Sugioka, "TELECOMMUNICATIONS SOFTWARE DEVELOPMENT: TODAY AND TOMORROW"
IEEE GLOBECOM'88, P.730-P.735, 1988

[3] K.Nakamura, "A PRACTICAL APPROACH TO TELEWORKING USING DISTRIBUTED SOFTWARE TECHNOLOGY"
PTC'89 Proceedings, 1989

[4] K.Nakamura, "VISUAL REPRESENTATION METHODOLOGY FOR THE EVALUATION OF SOFTWARE QUALITY"
IEEE GLOBECOM'89, 1989

[5] K.Nakamura ,J.Tsuboi, "THE REPORT ON TELEWORKING"
PTC'90 Proceedings, 1990

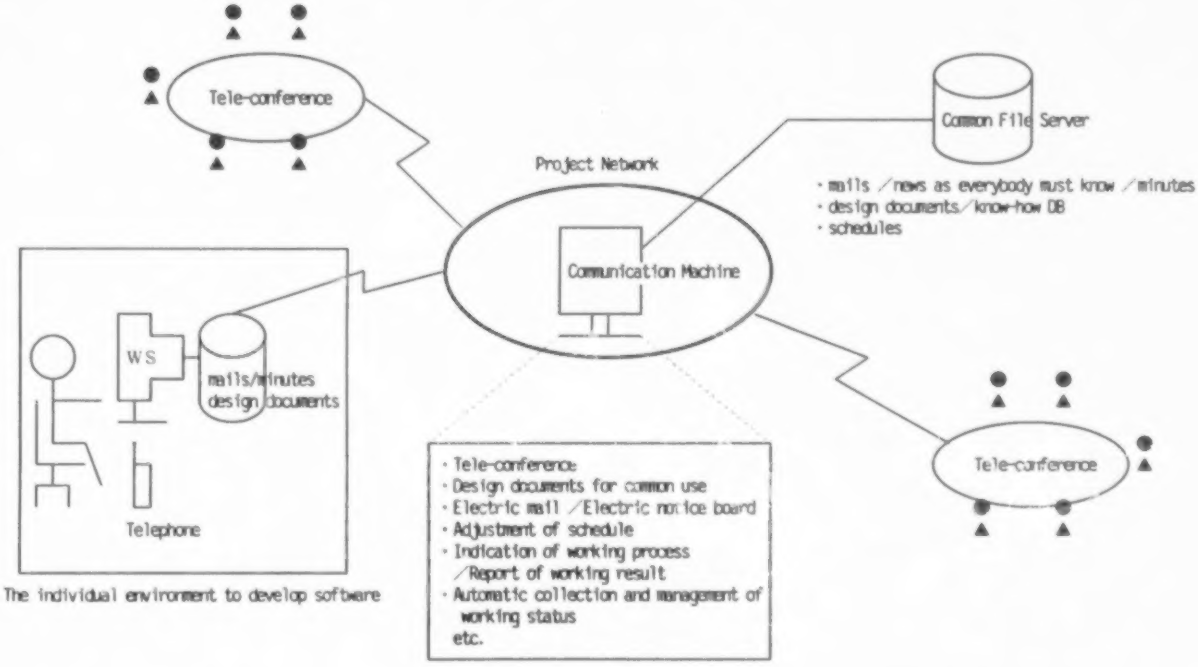
Tele-conference
Project Network
Common File Server
· mails / news as everybody must know / minutes
· design documents / know-how DB
· schedules
Communication Machine
WS
mails/minutes
design documents
Telephone
The individual environment to develop software
· Tele-conference
· Design documents for common use
· Electric mail / Electric notice board
· Adjustment of schedule
· Indication of working process
/ Report of working result
· Automatic collection and management of
working status
etc.
Tele-conference

Figure 3.1 The working model of Excellent-Work-Way

Is Telecommuting Real?: The State of California Experience

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Abstract

A brief overview of the history of telecommuting is given, followed by a description of the two-year comprehensive test of telecommuting by the State of California. The impacts of telecommuting during this period are discussed, together with some recommendations for further actions to be taken.

Background

Since we first began making field tests of telecommuting in 1973 there has been considerable skepticism as to the applicability of telecommuting to other than a relatively small group of individuals. Over the years several attempts have been made formally to demonstrate the validity of telecommuting, both in the private and public sectors, with mixed results. Some projects have been quite successful and have expanded beyond the test phase. Others have failed to grow or have failed completely. The failures, in my opinion, were primarily a consequence of management barriers of one sort or another. The fundamental requirements for successful telecommuting have not changed materially over the past two decades, although they have been widely misunderstood.

In the meantime, particularly in the 1980's as personal computers became ubiquitous, an exponentially growing number of individuals have invented telecommuting for themselves. These *teleguerillas* typically have made informal arrangements with their direct supervisors so that they could telecommute frequently, if not regularly. In most of these cases the employer has no formal program for telecommuting by its employees. I estimate that by 1990 there were at least 2 million telecommuters in the United States, mostly teleguerillas. Other estimates are higher. There have been no publicly available surveys of the impact of telecommuting on these telecommuters, their employers or their communities.

There have been many successful, continuing formal telecommuting programs in the private sector over the past two decades. However, the degree of success of these programs has not been well documented. This is largely a consequence of two factors. First, the corporate decision to continue, or discontinue, telecommuting is usually based on testing a few business-specific factors rather than on a comprehensive analysis of all the impacts of telecommuting. Second, successful programs are generally viewed as important competitive tools; companies have little desire to share with competitors the methods of deriving their advantage.

During the eighties, there was also a spate of theoretical discussion in the academic journals about the prospective ill effects and/or basic infeasibility of telecommuting.[2] None of this has had the benefit of empirical data.

Finally, the State of California began investigating the possibilities of telecommuting early in the 1980s, with an impact forecast project sponsored by the California Energy commission in 1983 and the implementation project described here. One of the purposes of the project was to make available to the public for the first time the results of extensive empirical research.

Definitions

Telecommuting needs to be carefully defined to eliminate confusion about what is–and isn't–telecommuting. Here are my own definitions, expanded from the 1973 original version:

1. *Home-based Telecommuting.* In this version, the employee works at home, keeping in touch with the main office mostly by telephone or other telecommunications technologies. Most home-based telecommuters work at home only part time, say, one or two days per week, spending the rest of their work time in the 'main' office or at other facilities. Home-based telecommuting is to be distinguished from home-based business in which the entirety of the individual's working time is devoted to his/her entrepreneurial activities; telecommuters are employees of other organizations. The transportation impact derives from their elimination of some trips that would otherwise be taken in a 'traditional' information work setting.

2. *Regional Center Telecommuting.* There are three variants of this, known as satellite center, local center and neighborhood center telecommuting. There are the following distinctions among these versions.

- *Satellite Centers* are facilities set up by relatively large organizations to house only their own telecommuting staff. Typically they house from twenty to more than one hundred workers, some of whom may still commute several miles to get to the center–as contrasted with tens of miles commute distances otherwise. Branch banks and fast food outlets are well established examples, provided that their employees are local residents. Note that, in the fast food outlet case, not all telecommuters are information workers.

- *Local Centers* are facilities that house a number of telecommuters, say 25 or more, from at least two different organizations (companies and/or government agencies) in a single structure. Except for the multiple tenant and decreased organizational representation factors, with their accompanying management issues, they are otherwise similar to satellite centers.

- *Neighborhood Centers* are smaller facilities, such as store front operations. They house just a few workers, less than 25, and can serve either as mini-satellites or mini-local centers. The emphasis here is on neighborhood: each such center would be within a few blocks, walking distance, of the workers' residences.

For all of these options the common criterion is that the centers are close to where the telecommuters live (with the neighborhood center being the closest) and the telecommuters work there instead of at home. Clearly, however, some telecommuters do and will share their work time among two or more of these options, including working at the distant central facility.

3. *Information Workers* are individuals whose livelihood depends mostly upon their ability to create, manipulate, transform or disseminate information, or to operate information machines. The majority of workers in developed countries are information workers. In California, about 60% of the workforce comprises information workers; about 30% of those may not currently have jobs that are suitable for telecommuting, in principle about 20% could be home-based telecommuters.

4. *Telecommuters* are individuals who telecommute with some regularity, typically at least one day per week, on average.

5. *Telemanagers* are direct supervisors of telecommuters.

6. *Telecommutable tasks* are tasks that are *location independent:* the person performing them can perform them almost anywhere. Telecommutable jobs are jobs (such as secretary, lawyer, engineer, judge) that include enough telecommutable tasks so that the job holder might be able to telecommute in full-day increments.

The California Project

The California Telecommuting Pilot Project was first planned in 1985.[3] The planning project was instigated by the Department of General Services as part of an attempt to reduce demand for office space. A Telecommuting Advisory Group was formed comprising representatives from the major State agencies with potential telecommuter populations. JALA Associates was engaged by the Department of General Services to help develop the plan. The plan recommended a two-year pilot project involving about 200 telecommuters, 100 telecommuting from home, the other 100 at satellite telework centers, as well as a control group of comparable size and composition.

Starting in mid-1987, final selection began of participating State agencies, managers and telecommuters. JALA Associates was engaged to provide consulting, training and evaluation services for the project. The Project Manager throughout the planning and implementation phases was David M. Fleming of the Department of General Services.

Training of the first groups of telecommuters and supervisors occurred in January and May 1988. The project also included some individuals who had been telecommuting prior to the official start of the pilot project. The active implementation phase of the project ran until January, 1990. Participants in the project, as well as a "control" group of similar State employees, were surveyed at intervals through the project (including intensive annual questionnaires) in order to test the impacts of telecommuting. An additional random survey was made in December, 1989, of more than 500 State employees who were information workers in order to test the applicability of the pilot project data to other areas of State government.

Rationale

There were, and are, many stakeholders in the Telecommuting Pilot Project. Stakeholders are individuals or groups who have an interest in, or are affected by, the outcomes of the project. Primary stakeholders[4] include the telecommuters themselves, their direct supervisors, their families and colleagues, the organizations *in* which they work, the organizations *with* which they work, organized labor groups and State government in general. Secondary stakeholders[5] include the communities in which telecommuters live and/or work, various agencies of government at the local, state and national levels (in the U.S. as well as in other countries), manufacturers and the distribution channels for information technologies and office equipment, the business community, the research community, consumer advocacy and other special interest groups, etc. Each of these stakeholders or stakeholder groups has a set of specific interests and priorities for judging the outcomes of the project. Often the interests of different groups coincide; at least some of the time they conflict.

Telecommuting, if it becomes widespread, can affect almost every aspect of contemporary life, from fundamental job patterns, to the physical structure of communities, to broad scale environmental changes such as global warming, to global economic competitiveness. Thus, we have attempted in the evaluation of this project to address as many as possible of the major issues affected by telecommuting.

Telecommuting is fundamentally an organizational technology, even though it is dependent on telecommunications technology for its practicability. Because telecommuting does involve social change we felt it important to test its validity over a sufficiently extended period. We particularly wished to get to the point where telecommuting was viewed by its practitioners as ordinary business rather than as an innovation. That is, we were trying to get past the "Hawthorne effect" stage of technology diffusion. Consequently, the nominal test period was kept at two years rather than the six months or so common to many pilot projects. The latter are often criticized as being misleading because they were still at the "gee whiz" stage of development when the results were announced, with the "Oh, my God" phase yet to appear.

This attempt was necessarily moderated by the constraints of budget and time – and the patience of the telecommuters and their supervisors. Budget and time constraints dictated investigation by questionnaire rather than the more expensive and time consuming interview process. Respondents' patience limits constrained the length of the questionnaires (the final, 'abridged' questionnaire contained 466 items) and the frequency of their administration. Considering the time required to complete the questionnaires, the response rate of 100% in many of the agencies is quite gratifying. In addition to the annual round of questionnaires, the participants and their driving age family members were asked to complete logs of their automobile use for periods of three consecutive days, once before telecommuting began and at the end of the first year of telecommuting.

Objectives

The California Telecommuting Pilot Project had the following primary objectives[6]:

1. To assess the impact of telecommuting on the effective delivery of existing State services;
2. To determine the consequences of telecommuting for managers and employees of state agencies, including the quality of work life within state agencies;
3. To explore the possibility of new state services made possible by telecommuting
4. To evaluate the opportunities created by telecommuting for the employment of, and the enhancement of working life for, persons with disabilities;
5. To test a results-oriented management approach as a key tool for successful telecommuting;

6. To develop improved tools for selecting, training and evaluating telecommuters and supervisors of telecommuters;
7. To estimate the impact of telecommuting on reducing traffic congestion, air pollution and energy use;
8. To develop guidelines for expanding telecommuting generally within state government, and;
9. To develop and test ways of equitably sharing office space and reducing total space requirements.

The Basics

At the end of 1989 there were about 150 telecommuters participating in the project, mostly located in northern California, mostly from 6 of the 14 participating State agencies:[7] California Energy Commission, California Youth Authority, Department of General Services, Department of Social Services, Franchise Tax Board, and the Public Utilities Commission. The Public Utilities Commission telecommuters live primarily in the San Francisco bay area, while most of the rest of the telecommuters live in the Sacramento area. In January, 1990 another group of telecommuters from the Department of Justice was added, all of whom live in or near Los Angeles. Test results from that group, after 10 months of telecommuting, are comparable to those of the group covered in more detail here.

Most (72%) of the telecommuters consider themselves to be professionals, with jobs ranging from accountant to researcher and including administrative law judges, lawyers, policy analysts and appraisers. Secretaries and clerical workers constitute 3% of the telecommuters, individuals who are primarily managers form another 3%, and those who consider themselves to be both managers and professionals make up 18% of the group. The average telecommuter is 41 years old, has worked for the State 14 years and 64% are male. The control group differs slightly from these figures, averaging 40 years old, with 47% males. Table 1 provides more details.

The median commute distance for the telecommuters is 20 miles, covered in 40 minutes (averaging 30 mph). The controls' median commute is 12 miles, covered in 30 minutes (averaging 24 mph). One telecommuter's 'commute' is 210 miles, while the most distant control lives 200 miles from work. Almost all of the telecommuters work from home only part of the time, spending the rest of the time in their traditional office. The average in December, 1989 was 1.5 full days and 0.2 partial days per week at home, as compared with 1.2 and 0.3 days per week, respectively, the previous year.

Exactly half of the telecommuters used their own personal computers when they worked at home and only 23% didn't own a computer when we completed the mid-term survey of the participants. By December, 1989, PC ownership had climbed to 84%, with 58% of the telecommuters using their PCs for work. Ninety percent of the telecommuters own their own homes (single family detached structures), the average size of which is 1756 square feet – 134 square feet of which is used generally, and 69 square feet exclusively, for telecommuting. That is, their home offices are about the same size as their current downtown offices.

Results and Lessons Learned

The project has met or exceeded all of its key success criteria[8]:

Impacts on the Delivery of State Services

Telecommuter work effectiveness has fulfilled or exceeded expectations. We assessed the impact of telecommuting on the effectiveness of delivery of existing State services by means of evaluation questionnaires administered to the telecommuters, members of a control group and direct supervisors of both groups. All were asked to evaluate their (or their subordinates') changes in effectiveness over the two-year period of the pilot project. As expected, many telecommuters experienced 'break-in' strains for a few months as they became acclimated to this new way of working. We expected stable conditions to reign by the end of the first year. The average difference between the effectiveness self-assessments of the telecommuters and the controls was 6.7% at the mid-term and 10.4% at the final survey. Supervisors' assessments of their telecommuter-control effectiveness changes were 2.3% at the mid-term and 6.8% at the final evaluation. That is, the telecommuters have grown steadily more effective over the past two years, relative to members of the control group, in delivery of their services. Earlier fears seem unfounded that the positive impacts of telecommuting would "wear off" over time.

There are also some infrastructural changes that are important. First, telecommuters are more dependent on the use of the telephone, and grow to use it more for such activities as coordinating tasks. Although this growing dependence on the telephone network might seem to be a possible weakness, events have proven otherwise, as demonstrated by the Public Utility Commission's telecommuters to continue working without interruption after the 1989 major earthquake. The latter is a clear case of delivery of State services that otherwise would have ceased.

Second, telecommuters are more likely to become computer adept. Although we did not collect data on the relative levels of computer use between the telecommuters and the control group, my private sector experience has shown this to be the case. Less than 20% of the telecommuters *don't* own personal computers. To the extent that computer facility improves effectiveness, then telecommuters are likely to be on the leading edge of those improvements.

Impacts on Managers and Employees

Telecommuting enhances the quality of work life for telecommuters, including those with disabilities. The impact of telecommuting on the telecommuters has been very positive, as determined by a variety of measures besides the effectiveness changes. Quality of life changes, both at work and at home, have been particularly important to the telecommuters, with improvements in the ability to concentrate on crucial tasks and to get more done, freedom from interruptions, increased creativity and improvements in personal life steadily increasing over the life of the project.

We did not make as detailed assessments of the impacts on managers, other than asking for self assessments in changes in effectiveness and work load. Most of the supervisors noted no change in their work load, although 3% reported significant increases. While 47% of the supervisors estimated no change in their effectiveness, 40% reported slight to significant improvements in their own performance. Supervisors' and subordinates' self-estimates of effectiveness and work load changes are closely correlated. That is, both parties appear to win when telecommuting is effective.

Possible New State Services

Although we did not test any new State services, the success of telecommuting suggests examination of some possibilities. Those discussed elsewhere in this report are: expansion of Employment Development Department services to take advantage of teleworking arrangements; development of regional telecommuting centers in low income areas as a means of job development and training; development of increased work opportunities for the mobility impaired; and localizing of specialized State services. An example of the latter would be easy tele-access in Yreka or Chula Vista to expertise in Sacramento for bridge design stress analyses.

Opportunities for the Disabled

Telecommuters who had mobility disabilities and were involved in the project found that their work-related stress levels significantly decreased as a result of telecommuting. Their effectiveness changes were positive, like the rest of the telecommuters. We did not specifically explore new job opportunities for the disabled; however, telecommuting clearly appears to benefit the disabled. Few information jobs have inherent restrictions to entry if telecommuting is an option for the employee.

Results-Oriented Management

Telecommuting requires a results-oriented management approach: managing the work instead of the worker. A frequent comment from managers new to this approach (such as during our training sessions) has been: "we should do this for *all* of our employees!" The effectiveness survey results tell the tale: the management-by-results approach produces increased performance for telecommuters and controls alike, when both supervisor and employee have received training in the methods.

Selection, Evaluation and Training Tools

The selection and training and evaluation tools used for the project had already been tested extensively in the private sector and proved suitable for the Pilot Project as well. In some cases where the selection questionnaires were not used, or the resulting recommendations were ignored, employees subsequently quit telecommuting or their performance failed to change. The average effectiveness rating difference was 11% between those telecommuter-supervisor pairs who attended the pre-telecommuting workshops and those who didn't. The evaluation questionnaires have yielded a great variety of data, all pointing toward the clear conclusion that properly managed telecommuting works very well for all concerned.

Environmental Impacts

Telecommuting has been shown to have significant potential for reducing traffic congestion, air pollution and energy use. Both our data and the results of a parallel transportation study conducted at the University of California, Davis show major effects of telecommuting on reducing traffic congestion, air pollution and energy use. The average telecommuter worked at home 1.5 days per week (6.5 days per month), during which time the telecommuter's car was not used for other purposes. Further, total car use decreased in 22% of the telecommuters' households– over and above the decrease due to reduced commuting. If expanded telecommuting follows the same patterns as those of the Pilot Project, then there would be about a 35% reduction in commute car use for each telecommuter.

Guidelines for Expanding Telecommuting

The random survey of State information workers leads me to believe that there is no reason why telecommuting could not be extended to all State agencies. A subcommittee of the Telecommuting Advisory Group is developing a comprehensive set of expansion guidelines.

Potential for Office Space Sharing

Equitable means have been developed for sharing office space and reducing total space requirements (although these have not been fully tested yet). We conducted a design study for shared office space, in conjunction with the design firm Sanchez/Kamps. Designs were developed for a variety of work modes and office types. We estimate that office space demand could be reduced by about 3/4 for typical part-time home-based telecommuters– without inconvenience to the telecommuters. Greater savings were realized by one test arrangement made by the Department of General Services. Unfortunately, budget constraints did not allow testing of other designs. Nevertheless, the potential exists and should be explored further.

Conclusions

Our in-person discussions and our questionnaire surveys and impact analyses during the implementation period lead me to the following key conclusions concerning the ***preconditions to telecommuting***.

- ✓ **Top-down support is vital.** A prerequisite to successful participation of an organization in any innovation is the support of senior management. It is also generally true that the agencies with the largest number of telecommuters (in proportion to their size) have the most active project representatives – or is it vice versa?.
- ✓ **Senior management support, although necessary, is not sufficient.** An active "champion" is needed in each organization to spark participation through the startup period. This and the previous finding underscores my contention that:
- ✓ **Telecommuters and their supervisors must be volunteers.** If either party feels forced to telecommute – or to supervise telecommuters, performance tends to suffer. This implies that telecommuting must be a management option.
- ✓ **Screening is important.** Not all employees can telecommute effectively, either because of the requirements of their jobs or because of personal and/or work-social considerations.
- ✓ **Training is the key.** We see significantly higher performance results when both the telecommuters and their direct supervisors have received telecommuting-specific training before telecommuting began.

- ✓ **Major capital investments are not necessary**. Few, if any, of the participating agencies were required to make unplanned expenditures for computers or other telecommuting-specific technology. Often, where telecommuters worked frequently from home, their State-provided computer was moved from their downtown office to their homes. Many telecommuters either do not use computers at home or already own suitable machines.
  - ◇ Nevertheless, computers will be an important part of telecommuting in coming years. It is important to begin developing policies for these uses.
  - ◇ Further, no satellite telecommuting office has yet been established, although we have already selected and trained a set of candidate satellite office telecommuters – and desirable satellite office locations; this is partially a result of State facilities budget restrictions.[9]

When those preconditions are satisfied, as they were for most of the participants, the following results can be expected.

- ✓ **Telecommuting more than pays its way**. There are a number of positive impacts of telecommuting. The average change in effectiveness of telecommuters is greater than that of the control group (a group chosen to otherwise match the characteristics of the telecommuters as closely as possible).

  Telecommuters use less office and parking space downtown.

  Telecommuting has been found to be very useful for retaining the services of mothers during maternity leaves, as well as keeping or attracting employees with scarce expertise or talents.

  The consequence of these and related impacts is that the pilot project, including all the extra planning and training, paid for itself early in 1989. Since those start-up costs are now covered, the State can expect to make a surplus on the continuing telecommuters. Benefit-to-cost ratios could reach more than 20:1 if the experience to date continues to be valid in future years[10].

  There were also non-recurring benefits, not counted on my estimates. For example, telecommuters in the Public Utilities Commission were able to continue working immediately after the 1989 Loma Prieta earthquake even though the PUC was officially shut down for the rest of that week.

- ✓ **There are societal benefits as well**. A number of benefits have been demonstrated to date that can not be measured easily in dollar terms. Disabled telecommuters find the strain of 'getting to' their jobs significantly eased.

  Telecommuters generally experienced more positive changes in their personal and their work relationships than did the members of the control group.

  Although some automobile trips are taken by telecommuters during their work-at-home days, there are net savings in automobile use – household-wide – over and above the direct telecommuting-induced savings. The energy saved by six or seven telecommuters in one year is equivalent to the average US annual household energy consumption. If large numbers of people were to telecommute there would be proportionate reductions in traffic congestion and associated air pollution.

Factor	*Telecommuters*	*Controls*
Number of Responses	107	141
JOBS		
Accounting	3.9%	0.7%
Architect	0.9%	0.0%
Corrections	0.0%	0.7%
Customer Service	1.9%	2.9%
Engineering	17.5%	15.0%
Field Service	1.0%	1.4%
Finance	1.9%	0.7%
General Administration	5.8%	4.3%
Human Resources	0.0%	0.7%
Information Services	8.7%	16.4%
Legal	11.7%	6.4%
Office Services	1.0%	9.3%
Office Systems	0.0%	0.7%
Planning	3.9%	2.9%
Policy Analyst	9.7%	7.1%
Program Management	6.8%	8.6%
Public Relations	0.0%	1.4%
Public Safety	1.0%	3.6%
Research & Development	9.7%	0.7%
Other	14.6%	14.3%
FUNCTION		
Manager	2.8%	5.7%
Professional	72.0%	60.7%
Both Manager and Professional	17.8%	18.6%
Para-professional	4.7%	4.3%
Secretary/Clerk	0.9%	5.7%
Other	1.9%	5.0%
Average Age (years)	41.0	39.6
Percent Male	64.2	46.4
Average Size of Work Unit	11.9	12.2
Average Tenure with State (years)	14.3	14.6
Median Tenure with State (years)	13.0	13.0
Average Tenure in Work Unit (years)	5.7	5.0
Average Tenure in Job (years)	4.7	3.6
Average Annual Salary ($ thousands)	42.3	38.1

Table 1: Participant Demography, Late 1989

- ✓ **But there are restrictions and possible "side effects"**. Some jobs are not 'telecommutable', nor are some individual workers' – or their supervisors'

– temperaments. Our random survey of State information workers leads me to conclude that about 15% of them could not telecommute at all at this time, because of job constraints, and about 30% have jobs suitable for some home-based telecommuting, with the remainder as candidates for satellite-office telecommuting.

In the cases where some of the preconditions were not met, such as inadequate selection or incomplete training, results tended to be poor or negative.

Telecommuting was a statistically significant factor in the decision by 3% of the telecommuters to move farther from work. Clearly, other factors, such as affordable housing, are also major influences, probably the dominant ones. Nevertheless, telecommuting could be perceived as having possible negative long term effects on travel patterns – unless more emphasis is put on establishing regional telecommuting centers in or near areas of affordable housing.

There may be negative impacts on work-group performance if telecommuters are not readily accessible face-to-face (although we have little evidence – and some counter-evidence – of this to date).

Recommendations

We felt that the results to date support expansion of telecommuting to other State agencies and, of course, to other types of organizations, public and private. We recommended that:

- **A State Telecommuting Advisory Agency should be established.**[11] Because successful telecommuting does require careful planning, selection, suitable information technology aids and training it is important that agencies new to telecommuting be given appropriate support in their start-up efforts. This can best be accomplished by a relatively small group of experts who would be available as advisors to the State agencies and personnel, help customize telecommuting to their particular cultures, help coordinate policy influenced by the impacts of telecommuting, and generally help improve the telecommuting process in State government. My recommendation was that this task should be given to the Department of General Services. The Department should take a leadership role in supporting agencies in their efforts to establish satellites and in coordinating joint efforts in facility sharing.
- **More effort should be given to establishing satellite centers.** Many telecommuters were excluded from the project because their work duties required them to be in an office but who otherwise could function as telecommuters. Had satellite centers been available during the project period this additional group would have been part of the project. Additionally in areas around Los Angeles, for example, steep gains in housing prices have forced many information workers into moving great distances from their jobs. Satellite office telecommuting could be a major improvement for these people. Finally, employees whose jobs are suitable for home-based telecommuting constitute a minority of the potential telecommuters. More than half of the State employees tested might be able to work at satellite offices. We recommended that pilot satellite offices be established in both northern and southern California as soon as possible.
- **Bilevel volunteerism should be a requirement.** It is my firm belief that the participation decision priorities must be top down; that is, from the agency director to the specific telemanager. A 'no' – but not a 'yes' – at any point in this chain must be able to override contrary votes among the downward links. A manager must be able to terminate telecommuting for any one of his/her subordinates who does not live up to their mutually agreed upon performance goals.
- **Pre-telecommuting screening and training should be mandatory.** We recommend that no further telecommuting by State employees be allowed unless the telecommuters and telemanagers are adequately tested and provided with pre-telecommuting training. Also, each agency should have a telecommuting "champion", who is at a relatively high level in the organization and who is an active proponent of telecommuting, to act as the agency coordinator of telecommuting development.
- **Continuing evaluation data are needed.** As telecommuting expands to other agencies, within agencies already in the project, and to other organizations, it is vital to keep track of the impacts during the learning and adjusting process. We recommend that new agencies, as they develop their own pilot projects, strongly urge their participants to comply with reasonable evaluation survey requests. It is also important to test the satellite office concept since many more State employees have jobs that require them to be in an office setting. Further, annual surveys for all telecommuting agencies would be desirable, at least for a few years, to help detect any undesirable long term trends (such as increases in commuting distances).
- **A set of uniform guidelines should be established.** With the aim of incorporating these recommendations and minimizing wheel reinvention, a set of guidelines should be established that apply to each State agency, providing a core set of operating policies and procedures but leaving room for each agency to develop additional rules for telecommuting adapted to their own operating conditions.

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[1] Major portions of this paper are extracted from the Executive Summary of the California Telecommuting Pilot Project Final Report. This paper represents the views of the author and is not necessarily endorsed by the State of California.

[2] For a review of this see Nilles, Jack M. Traffic Reduction by Telecommuting: A Status Review and Selected Bibliography. *Transportation Research* (1988) 22A(4) 301-317.

[3] See JALA Associates. (1985). *Telecommuting: A Pilot Project Plan*. Report for the Department of General Services. State of California. Los Angeles, CA.

[4] Those who are or can be immediately or directly affected by telecommuting.

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[5] Those who have a broad or indirect interest in some of the impacts, such as air quality, energy use, zoning, the economy, management techniques, etc.

[6] The first four items in this list are as set forth in Section 15276 of the Government Code.

[7] An additional 7 agencies participated in some or all of the selection and training processes but never began telecommuting.

[8] Details are in the section of the full report entitled: *Definitions and Objectives.*

[9] After the final report on the project went to the Governor, the Governor signed a bill to establish at least two satellite offices in California.

[10] The estimated actual annual benefit-to-cost ratios at the mid-term and final survey points were 0.9 and 8.0, respectively. Both of these ratios were heavily influenced by the non-recurring administrative costs of the pilot project. Our 1985 estimate was that the benefit-to-cost ratio at the end of the second year would be 3.2.

[11] The Governor signed the Klehs Bill, AB 2963, on 29 September 1990, enacting the essence of this recommendation.

EVALUATION OF THE HAWAII TELEWORK CENTER DEMONSTRATION PROJECT

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ABSTRACT

The Hawaii Telework Center Demonstration Project was conceived by the Hawaii State Department of Transportation (DOT) to test an innovative way to reduce traffic congestion. This paper describes the project and reports on the results of its first year of operation.

Seventeen employees from the Mililani area--seven from six different Hawaii State government agencies, and ten from five private sector companies--are using state-of-the-art computer and telecommunication technology to demonstrate that it is possible to move work on "electronic highways" instead of people on asphalt or concrete highways. They are proving that it is possible to substitute communications for transportation.

The Hawaii State DOT undertook the project, not only for its potential to reduce commuting travel, but also for its ability to produce many employer, employee, social, economic, energy, and environmental benefits. The project enhances State decentralization objectives by dispersing employment and economic development and opportunity throughout the State.

BACKGROUND

The Hawaii Telework Center is one of a six-part transportation plan to reduce traffic congestion in Hawaii. The six parts include: 1) highway infrastructure development and improvements, 2) a rapid transit system connecting outlying areas and the central business district, 3) a water ferry system carrying East, Leeward, and West Oahu commuters to the central business district, and tourists from the Airport to Waikiki and other resort and coastal destinations on Oahu, 4) Transportation System Management (TSM) efforts including high occupancy vehicle (HOV), contra-flow, and shoulder lanes, computerized traffic signals, on-street parking bans, "Beat the School Jam" Programs, flextime/staggered work hours, and ridesharing, 5) land use policies to close the gap between where people live and work, and 6) teleworking and other measures to reduce work, business, and public travel.

PROJECT ORGANIZATION

The idea of private sector involvement was fundamental to the project. State DOT planners decided that the project could best be planned, organized, and implemented by a task force made up of public and private sector executives and University of Hawaii faculty members. A Telework Center Task Force was organized on August 24, 1988, with three major committees: Technical, Marketing, and Evaluation.

The Task Force established five objectives for the Project. These were to:

1. Plan, organize, and implement a pilot project to test the telework concept for at least a one-year duration.
2. Enhance the use of state-of-the-art computer and communication technology to create a model workplace of the future.
3. Publicize the project to generate interest in telework and other decentralized work applications.
4. Acquire experience to design, operate and link future work centers, satellite offices, and new urban centers.
5. Evaluate the performance of the project participants and the effectiveness of the telework application.

The Task Force later added another objective to the project. This was to test "business on-line access" by arranging for businesses to electronically access State and County data bases to reduce business travel and to allow businesses to decentralize from the congested downtown area.

This report focuses on Objective 5, to evaluate the performance of the project participants and the effectiveness of telework centers.

PROJECT FUNDS

The Hawaii State DOT is indebted to the private sector for their commitment and contribution to the project. Private companies provided more than $300,000 of computer and related equipment for the project.

Photo and Sound Company, in coordination with the IBM Corporation, provided seven PS/2 Model 70 computers with printers and color monitors, Wang Laboratories provided a VS- 65 computer system, and the Xerox Corporation provided two Model 7021 facsimile machines.

A local developer, Oceanic Properties Inc., developed 2,000 squarefeet of new office space in the campus-like setting of the Mililani Technology Park. For a lease cost of $1.50 per square feet per month, Oceanic Properties provided a completely functional and attractive work facility built to the specifications of the project planners. The facility includes built-in work stations for seventeen employees, a lounge area, kitchen, equipment room, and a common work area. Electrical and water utilities, janitorial services, night and weekend security guard services, use of conference facilities, and free parking are all part of the lease rental.

The GTE/Hawaiian Tel Company provided the telecommunication links and services for the project, and ADMOR Distributors provided a refrigerator and microwave oven for use by all telework employees. Gray Associates provided several modems and Data, Tel and Power provided an uninterruptable power supply unit.

The Hawaii State Department of Transportation returned part of the $125,000 appropriated by the Hawaii State Legislature for the project because of the generous response from the private sector.

PROJECT PARTICIPANTS & PROJECT EVALUATION PERIOD

In selecting project participants, the Telework Center Task Force and project planners agreed that it was important to select as many types of job occupations as possible for the telework experiment. Occupations included professional and clerical jobs, particularly those that require word processing, spreadsheet, and database software applications.

The Telework Center participants at the time of the survey included employees from five different private sector companies including the Bank of Hawaii, Hawaii Medical Services Association (HMSA), IBM Corporation, Title Guaranty of Hawaii, and Inter-Island Legal Services. State government participants included employees from the departments of Transportation, Agriculture, Education, Taxation, Judiciary, and Budget and Finance. Participants included computer programmers and systems analysts, data entry operators, an education consultant, tax return examiners, claims resolution examiners, escrow document research and preparation personnel, and a stenographer.

The SMS Research Company conducted the project evaluation for a one-year period beginning in July 1989 and ending in June 1990.

DATA COLLECTION

There is no attempt to make any definitive statements on the project results since the survey group was small and included the facility administrator who conducted tours for over 2000 visitors at the telework facility during the past year. Instead of relying solely on surveys and figures, the Task Force felt that it was equally important to capture how the project participants, their supervisors and management felt about the telework experience. The evaluation team, therefore, conducted personal interviews to supplement the project surveys.

While the participation of diverse companies, occupations, and applications was encouraged, it made data collection and tabulation difficult. For example, employee interest was so intense in one company that the company selected eleven out of more than two dozen interested employees to rotate through its three work stations at the Center. Obviously, these employees did not fully benefit from travel reduction and cost savings as the other employees. Consequently, the evaluation consultant felt that the evaluation should target only 14-15 of the 25 employees who participated in the project surveys.

EVALUATION FINDINGS

The project evaluation team surveyed project participants in four general areas: 1) commuting travel assessment, 2) work productivity, 3) employee satisfaction, and 4) job relationships. The team also asked the teleworker's supervisors and managers to comment on the project.

Commuting Travel Assessment

An important feature of teleworking is its ability to reduce work trips, driving time, commuting costs, and fuel consumption. The evaluation team conducted surveys to find the magnitude of these reductions.

The survey results show that 93% of the employees reported trip reductions to downtown Honolulu, 100% reported driving time savings, and 79% reported travel savings and reduced fuel consumption. Employees reported a 76% reduction in the number of downtown trips, and saved an average of 7.4 hours per week in travel time, or 385 hours per year. They also saved an average of $13.26 per week, or $690 per year, in fuel expenses.

The survey revealed that not all employees had commuting time and cost savings. Some did not have cost savings because they were originally bus or auto riders, and some employees did some backtrack driving in dropping children off at school. One teleworker started the day at the telework center, left after the morning peak traffic period to see clients, and returned at the end of the day to prepare reports and to receive messages and return phone calls. But he did report travel time savings and less stress because he no longer made work trips during the peak traffic period.

Two employees summed up their teleworking experience as follows:

> *"I saved on gas, parking, and most of all...time. I cut my commuting time from 2 or more hours*

to less than 15 minutes a day. It's an impossible dream turned into a reality."

"One more hour of sleep every day and I am still able to get home at least an hour earlier too! This place is great! But that's not all - I can now get 3 weeks out of a tank of gas whereas working in town I would have gone only 4-1/2 days. Parking is another saving for me too. There is no 'free' parking in town. I think this place is just great!"

Employee Productivity

A frequently raised question about the telework center project was whether employees' productivity increased or decreased? The evaluation team directed this question to both the telework participants and their immediate supervisors for validation.

The survey shows that 12 of 15, or 80%, of the telework participants reported an increase in work productivity, one employee reported no change, one was less productive, and a new employee noted that there was no way to make a comparison.

Eight of fifteen supervisors reported an increase in telework employees' productivity, two reported no change, one reported a productivity decrease, and four reported that there was no way to compare.

Reasons offered for increased employee productivity include fewer work disruptions at the Telework Center with fewer phone calls, social and non-work related conversations, meetings, and distractions. Employees reported that the work environment was more conducive to productive work and supervisors reported work qualitative improvements in addition to quantitative improvements.

Employees also reported that reduced travel time resulted in a reduction of stress. The employees said they felt rested and far more relaxed upon arriving at work and had a clearer mind for effective problem-solving. The following are employee comments:

> *"I feel less stressed and less tired when I work at the Telework Center. I remember walking in the office in town to start work and feeling like I had already worked for half a day. Probably being less stressed and tired starting the day affects my productivity on the job. Teleworking gives me a quiet environment where I can do a lot of the 'deep thinking' tasks. There aren't as many interruptions and distractions here at the Telework Center as there are downtown."*

> *"The Hawaii Telework Center is a well-organized place to work. It is a relaxed environment where one works on his/her own without the outside pressure and interruptions you often have in a typical office environment. The money saved as well as time for not having to travel into Honolulu is God-send. There is no stress here at the Center. We are like a family, and yet we work for different companies and get along fantastically."*

> *"The best part of teleworking is starting my workday with a clear, uncluttered state of mind. I don't have the frustration of the traffic mess to darken my day and when I go into a customer's office on a problem, I feel I can listen better and fix the problem faster. On the days I have to be in town for an early meeting, it's a real effort to face that traffic again."*

Employee Satisfaction

Telework Center participants are generally very happy about their telework experience. They were surveyed on stress level, happiness, amount of time to relax and spend with their family, and other factors.

The survey results are consistent with personal observations and comments made by employees. It shows a significant improvement in employee satisfaction and quality- of-life improvement. Employees were pleased with their new work place and spoke freely of dramatic changes in their personal lives. They said:

> *"Prior to teleworking, I remember being very tight on time, especially in the evenings. I was starting work late to try to avoid peak traffic, and would therefore return home quite late in the evening.That left me with hardly any time to relax and enjoy the children. Now I get home at a more decent hour, and we have time to talk and play with the kids."*

> *"I now have extra needed time for my family and for myself to do things I could never do. It was always not enough time...too tired...I'll do it tomorrow. Tomorrow came, and there still wasn't enough time."*

Job Relationships

The final survey area was on job relationships and opportunities. Questions were asked on relationships with supervisors, missed opportunities, and work location preferences.

All fifteen employees said that they would rather work at the Telework Center than at the main office, and all 15 employees said that, given the opportunity, they would prefer to keep working at the Telework Center.

Supervisor Evaluation

The evaluation team asked the immediate supervisors of fourteen teleworkers to comment on the telework experience. The team asked qestions in the areas of: training, productivity, independent work, promotion opportunity, and continued participation. These were the responses:

1. **Training:** All supervisors began the project with the belief that telework would work well for their companies. They felt that they

probably would encounter problems along the way but would not require any special training to solve them. Two supervisors did receive special training, but after the first year's experience, no one felt that special training was really necessary.

2. **Productivity:** Only one supervisor felt that his employee's productivity was less than before the telework experience while the majority felt that their employees were more productive. All felt that the Telework experiment had a positive effect on their employees with a few remarking that their employees had grown as a result of teleworking.

3. **Independent Work:** Supervisors were evenly divided in their opinion about the ability of employees to work independently. One-third felt that employees were more independent than they had been in the home office; one-third felt they were performing about the same; and the final one-third said they didn't have enough data to make a decision. No supervisor felt that any employee required more supervision than they had at the home office.

4. **Promotion Opportunity:** Initially, three of fourteen supervisors felt that working at the telework center would hurt an employee's chances for promotion. During the year of operation at the center, a total of nine employees were eligible for promotions. Of these, two were promoted. Supervisors judged that six would not necessarily have received promotions regardless of where they worked. The ninth elected to remain at the Telework Center rather than move back to town to take a promotion.

5. **Continued participation:** Ten of fourteen supervisors reported that they would like to keep their current employees at the Center, and ten said they would like to send more workers to the Center. Three were unsure, and only one reported that they would not like to continue participation.

Management Comments

The evaluation team also asked eight managers who made decisions to participate in the Hawaii Telework Center project to comment on the telework experiment.

Managers were generally very positive in their assessment of the project. They were pleased to be part of the project and had favorable comments about how the project was organized and conducted. They did not have any major problems to report and were unanimous in their appraisal of the value of the project in testing a promising new work concept.

On the question of money saved for the company including the reduction of expenses for office space, parking, transportation, equipment, and other expenses, only one manager felt that the telework experiment had saved the company money. However, most did not expect any savings. First, companies had far too few individuals at the Center to expect meaningful savings; and secondly, most of these companies made substantial investments in computer hardware and software and business systems to be in the project. These initial investments more than offset the other savings.

Noteworthy is that three of the eight managers are sold on the telework center concept and their companies are now developing telework plans of their own. One is planning to build its own telework center next year; another is currently looking for available space; and the third can integrate telework applications in existing branch offices. Others indicated a need for additional time and data to evaluate the long-term costs of teleworking.

Employer Benefits

Employers can profit from a number of telework benefits. These include:

1. **Cost Savings:** Telework centers provide an opportunity to get work done at lower costs. Office space vacancy rate in downtown Honolulu is the lowest in the nation at 2.5%, down significantly from the 4.7% vacancy rate recorded a year earlier. Average monthly rent for downtown office space is $2.20 a square foot, with some as high as $3.13 a square foot and parking is between $100 and $235 per month. By comparison, lease rate in suburban Honolulu is $1.50 a foot and includes free parking and other privileges. Telework centers further make job sharing, space sharing, and additional shifts viable as work options since employee work commuting time and expenses can be significantly reduced.

2. **Access to Labor:** Hawaii's unemployment rate is currently the lowest in the United States at 2.8%. National demographics show that the problem will be with us for a long time as a result of the Baby Boom/Bust syndrome. Telework centers make it possible to expand the recruiting base beyond the normal commuting area, including distant labor markets, neighbor island residents, and employees who do not work because of transportation problems and expenses.

3. **Increased Productivity:** There is no reliable data on Hawaii worker productivity, but American businesses are acutely aware of employee productivity as a major challenge in maintaining international competitiveness. The development of a new enthusiastic work culture offers the possibility of increased worker independence and productivity.

4. **Technological Opportunity & Competitive Advantage:** As America moves into the 21st Century and the Information Age, advances in telecommunications will affect all types of businesses, making increasing numbers of jobs compatible with computer and electronic technology. This involves not only the computerization of jobs and continuing advances in video and data communication,

but also the increasing availability of information through communications. Employers and their employees will be required to deal with these technological advances and to be increasingly familiar with telecommunication solutions to business problems. Firms, which can access non-standard labor pools and offer attractive employment opportunities and new employee benefits, will have the competitive advantage. In addition, such firms will create images of being progressive and caring for their employees.

TELEWORKING - PROSPECTS FOR THE FUTURE

Many business factors are emerging which will enhance teleworking as a viable and attractive new work option. Among these are the rising cost of working and doing business in the downtown area - including downtown office space shortage and costs, downtown parking space shortages and costs, and labor shortages - in addition to commuting congestion problems.

Hawaii appears to be well-suited for the development of teleworking. Its spirit of Aloha and cooperation, as seen in the Hawaii Telework Center Demonstration Project, helps its people to work and put things together, and to easily adapt to a new work concept and culture. Both the public and private sectors were involved and contributed resources and participants. Each company was a pioneer in its own right by being willing to venture into "untested waters". The will of companies was important in overcoming the impediments to teleworking.

This cooperative spirit can help Hawaii assume a national leadership role in telework and telecommunication applications in the 21st Century. Business "on-line access", which was also tested at the Telework Center, is another telecommunication application that can help reduce business travel and make business and other information more accessible. Business "on-line access" will have high-impacting implications on local, national, and international levels in the Information Age and its high wage economy.

While the Hawaii Telework Center evaluation documented the more obvious benefits of teleworking, this Section expands on the changes that telework and communication technology are capable of making in the office, family, and community. These include: 1) working conditions, 2) work and management processes, 3) labor market impact, 4) family lifestyle, and 5) community involvement.

Working Condition

The study revealed that improved working condition is an important telework benefit. Employees begin with a shorter trip to work and end with a shorter trip back to home, and therefore, have more time to spend with their families.

At the workplace, employees developed a sense of self- esteem because telework required them to be innovative and to problem-solve on their own on many occasions. Employees generally felt good about being independent and being placed on a high level of trust and confidence by management. Reciprocally, they were generally perceived to be more responsible and loyal to their companies.

Second, the concern that teleworkers would experience a sense of isolation was quickly dispelled. Employees were not isolated because they developed a work culture suited to the environment. They got to know one another and discovered shared interests in lunch conversations, collectively dealt with technological problems, and invented their own work community rules and procedures. The differences in the kinds of work they did for their employers seemed less important than the similarities in work processes. It may be that a refreshing work culture, tied to a pleasant work environment and tangible benefits, will make telework centers the preferred work mode of the future.

Work and Management Processes

The growth of telework centers in Hawaii must be accompanied by the development of new work and management processes. Work processes must obviously change to take advantage of technological innovations, and changes must also take place for remote and decentralized operations. For example, in order to decentralize a filing operation, it is first necessary to develop an automated filing system that is accessible from a remote location. Industries and firms that have already automated their operations will probably be the early adopters of telework. Telework's success will likely increase the demand for hardware and user-friendly software systems.

The development of telecommunications processes must be accompanied by work processes suited to telework. This process usually requires the reconceptualization and reorganization of work processes to accommodate remote operations. The growth of telework centers is likely to be marked by innovation in existing business formats. Impediments to telework development may be institutional more than technological.

Teleworking must be accompanied by the development of new management styles. Several firms were initially concerned about the aspect of supervisors not being able to monitor and direct the actions of workers who cannot be seen. Most supervisors who participated in the Hawaii Telework Project had similar reservations but were able to work the problems out without much difficulty. Two supervisors did receive training in remote management techniques, but both said that the training was not particularly helpful. They concluded that their basic management skills were sufficient for carrying out the change. However, with less skilled managers and supervisors, telework training must be considered to be an essential part of the telework implementation process.

Labor Market Impact

In light of today's tight labor situation, teleworking will provide employers with improved access to labor and the labor markets. It can help retain valued employees and allow them the opportunity to continue rewarding employment without long commutes. Teleworking can provide new access to previously untapped labor sources such as neighbor island residents, people with disabilities, people without adequate transportation, spouses of military personnel, and college students.

Teleworking removes the hassle, time and expenses associated with work commuting, making job sharing and part-time and temporary employment reasonable work options. The same telework station can be used by different workers on a weekly, daily, shift, or even hourly basis, adding to labor and facility efficiency and taking advantage of labor available on variable scheduling.

Family Lifestyle

Both parents in an increasing number of American households now work, and many parents now spend a considerable amount of time working and commuting. The work-commute day could easily be from 6 am to 6 pm.

One employee sums up her commuting schedule:

> *"Typically, I wake up at 4:15 am. I leave home at 5:30 and try to find street parking, and walk to work and start by 6:30. If I'm late, I have to pay $6.00 a day to park in the company parking lot...I never see my three children in the morning. They get up and get dressed, fed, and off to school by themselves."*

Children are the unfortunate victims of the work-commuting syndrome. They are today's latchkey children who not only wake and go off to school by themselves, but also return home to empty houses.

Parents desperately need their employers' help. Employers, on the other hand, need to recognize what tremendous resources parents are, and to do more for them because it is increasingly difficult to be good employees and good parents.

Teleworking can provide a partial solution to today's families' predicament. It brings "JOBS NEAR HOMES", and can help bring fresher, less stressed parents home a lot quicker to their children.

Community Involvement

Teleworking can change employment patterns, working conditions, and foster wide changes in employees' lifestyles.

Teleworkers will be in daily contact with other members of their own community at the telework center, and will invariably develop more awareness and interest in community affairs. Because they will be home earlier, there will be more opportunities to be involved in school, church, youth, and community activities.

Overall, telework will develop a growing emphasis on the community and the family. Telework can help produce better citizens.

CONCLUSION

The Hawaii State Department of Transportation substantially met its project objectives in pilot-testing the telework center concept, gaining valuable experience in remote work concepts, and evaluating the results of its pilot project.

The project surveys and interviews show teleworking to be a promising work concept. Seventeen employees demonstrated that they can be equally or more productive as teleworkers. Work quality can also improve as employees grow toward greater maturity and are able to think out work processes for themselves.

Teleworking can open opportunities for new job candidates, including parents who need to be employed close to home, the transportation - disadvantaged people with disabilities, neighbor island residents who wish to be employed with Oahu companies, and residents living in rural and other remote areas. Teleworking can also bring new job candidates to the labor market by offering new work options and new work opportunities.

In summary, the project is a modest effort in specifically pilot-testing the telework center application of teleworking. The project provides employees, supervisors, and management from both the public and private sectors with hands-on experience with the telework center concept and the impetus for many other states to start planning telework centers of their own. The center essentially replicates an office environment but reduces the time and stress involved with work commuting.

Teleworking, as demonstrated, can be more than a travel and traffic reduction measure. It provides "JOBS NEAR HOMES" and can bring significant quality-of-life improvements for employees and their families.

EMERGENCY PUBLIC WARNING SYSTEM PILOT PROJECT

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ABSTRACT

A number of significant disaster events in the Edmonton region, which have caused severe damage, injury and death, have created a need for an emergency public warning system. The purpose of such a system is to provide timely and accurate warning information to the Edmonton area residents through all area broadcast media. In this pilot project, ACCESS NETWORK's CKUA-FM will relay public warnings simultaneously to all Edmonton area radio and television stations for immediate broadcasts through its SCA (Subsidiary Carrier Authorizations). This will become a prototype for a future province-wide emergency public warning system in Alberta, using CKUA's 15 FM transmitters located throughout the province.

A number of significant disaster events in the Edmonton Region, prior and subsequent to the July 1987 Tornado which caused severe damage, injury and death, have heightened public awareness of disaster potential and a need for an adequate public warning system.

The public warning system, which will be become operational in 1991, will speed up emergency warning messages so that they will be broadcast within minutes of a pending disaster situation. Why is there a need for an improved emergency public warning system?

The Edmonton Region with a population of 775,000 has been subjected to a number of potential disaster events. These include:

-39 petrochemical industry sites with a number of them producing or storing hazardous materials.

-8 hazardous material incidents occurred in the Edmonton Region within the most recent year with some having the potential to cause damage to property and injury to the population.

-12 weather related warnings were issued for the Edmonton Public Forecast region within the most recent year.

-26 severe weather events occurred within the most recent year in the Edmonton Public Forecast Region.

The Edmonton Region Emergency Public Warning System is a two-year pilot project intended to coordinate and enhance present municipal initiatives and efforts to develop an effective public warning system in Edmonton Alberta, Canada.

The purpose of the emergency public warning system is to provide the timely and accurate warning information of imminent or potential danger to people or properties through all area broadcast media.
Such warning information will include major emergencies and disasters.

More specifically, the project objectives are as follows:

-To ensure that emergency public warnings are delivered to the public in a timely and informative manner ;

-To institute procedures which will allow all broadcasters to inform and instruct the public in the event of life threatening emergencies;

-To provide a service to the public in alerting them to pending emergency situations with recommendations of actions to be taken; and

-To allow for the updating of information to the general public as to the status of an emergency situation and amend recommendations or precautions.

The project is sponsored by a multi-group of participants, including governments and agencies at the federal, provincial and municipal levels. They include:

* ACCESS NETWORK CKUA FM
* City of Edmonton
* City of Fort Saskatchewan
* County of Strathcona
* Strathcona Industrial Association
* Alberta Weather Centre, Environment Canada
* Radio/Television News Directors Association (In Edmonton)
* Emergency Preparedness Canada
* Communications Canada
* Alberta Public Safety Services

The project will use the radio broadcast facilities of CKUA-FM, a province wide educational/public broadcasting system. The SCA (Subsidiary Carrier Authorization) of CKUA-FM will enable public warnings to be relayed directly and simultaneously to all Edmonton Area AM, FM, and television stations for immediate broadcasts. The participating stations include:

CFRN-AM
CBX-AM
CFCW-AM
CKER-AM
CHQT-AM
CJCA-AM
CHED-AM
CHMG-AM
CKUA-AM
CJKE-FM
CBX-FM
CKRA-FM
CHFA-AM
CISN-FM
CIRK-FM
CHNG-FM
CJSR-FM
CKUA-FM
CITV-TV
CFRN-TV
CBC-TV
VIDEOTRON CABLE
SHAW CABLESYSTEMS

Selected hospitals, schools and other institutions will also receive the direct broadcast warnings.

Why is there a need for a coordinated public warning system? The reasons for this are as follows:

-A number of different agencies currently issue emergency public warnings through separate systems, leading to public confusion.

-Emergency Public Warnings are handled differently by each media broadcast outlet relaying the warning.

-Many media broadcasters do not understand the difference between various types of warnings and the levels of dangers that each one poses to the public.

-There is no coordination plan for the issuing of emergency public warnings or instructions to the public subsequent to an emergency public warning.

ACCESS NETWORK's CKUA-FM will operate and maintain the entire system. The Edmonton Region Broadcasters will operate and maintain the system receivers provided for their broadcast facilities, which will be tuned to accept the incoming warning messages from the system and will immediately rebroadcast all warnings and emergency information messages verbatim during any pre and post disaster impact period. This will continue until such time as the authorized user who activated the system discontinues the emergency warning process.

Each transmission of a message on the system will commence with a frequency tone of ten seconds duration which will precede the message.

Warning messages acceptable for broadcast on the System must contain the following basic information:

-The type and nature of the emergency must be clearly stated at the beginning of the message

-Identify the area and population at risk using specific geographic descriptions understood by the general public

-Describe, in concise terms , measures that members of the public may take for self protection, or to protect property

-Provide time lines stating the expected duration of the emergency situation

-Authorized users enter the assigned security code using a touch tone phone. The central control unit responds to indicate readiness to accept a voice message, or provide a list of menu choices of pre-recorded messages.

-The authorized user then enters the information requested and responds to any instructions given by the central control unit.

The system is intended to be activated only for emergencies and disasters which are of a severity or scale that they require response beyond the normal scope of emergency response actions and have the potential for threatening large numbers of people or causing widespread damage to property.

When in the judgement of any authorized user imminent danger exists to any portion of a community or communities, such authorized user may activate the system. The danger should be of such a nature that the possibility exists for serious immediate damage to property or threat to human life and health.

An authorized user may activate the system to issue vital safety instructions to persons affected by either imminent danger or an actual disaster event.

The major component and plan of the Emergency Public Warning System consists of an electronic system for the dissemination of emergency public warning messages and follow up information to broadcast media outlets and various other key locations in the Edmonton area. It will be activated by telephone or radio contact with a dedicated IBM AT Computer through ACCESS NETWORK CKUA-FM and activated only when there is imminent danger to all or any portion of a community in the Edmonton Region.

An operational plan has been developed in conjunction with and full cooperation and support of all radio and television broadcasting stations within the Edmonton area and the Radio and Television News Directors Association. The plan includes:

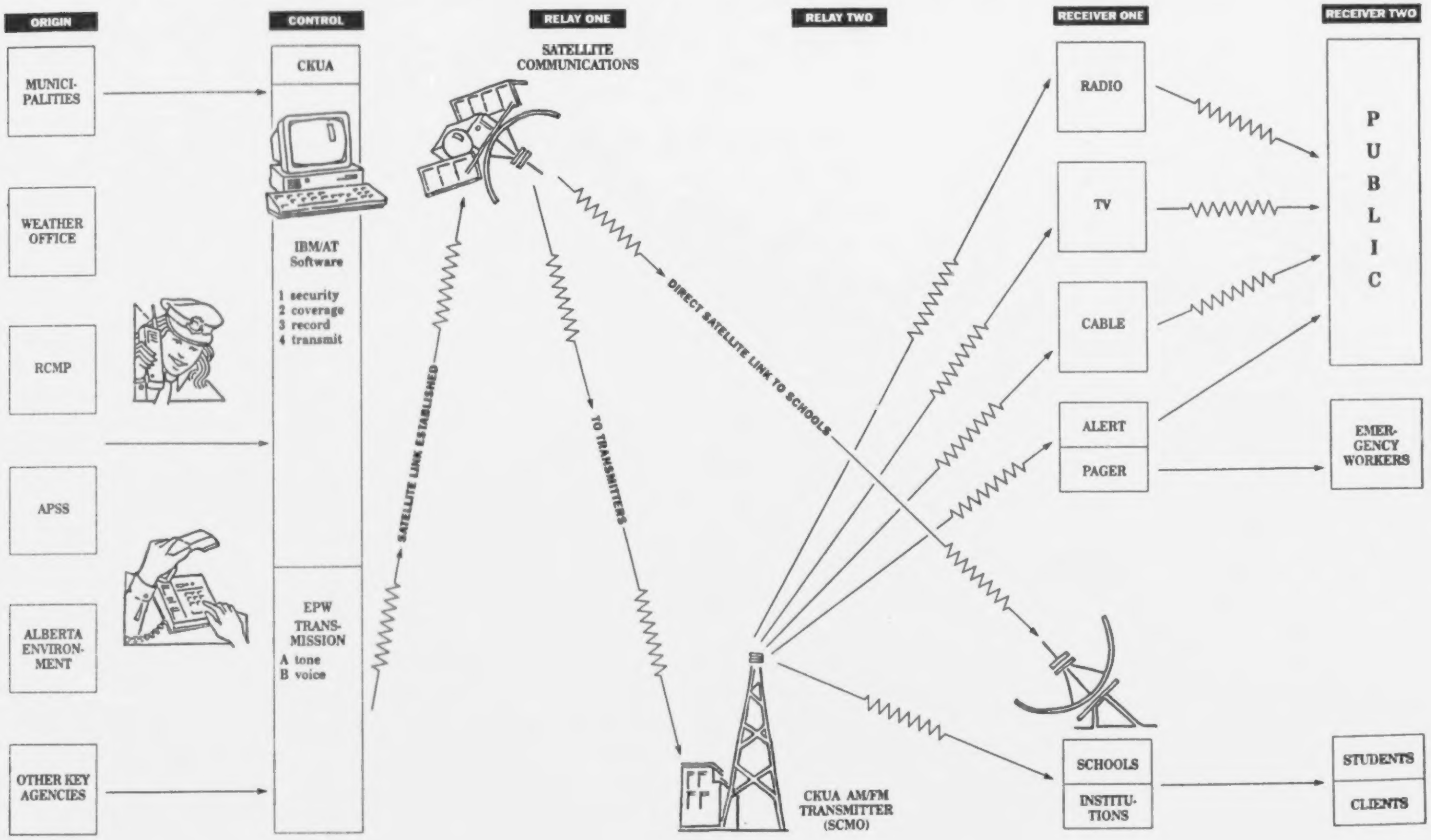
a) control the content of messages,
b) the manner in which they are relayed to the public and
c) provide an ongoing vehicle for public education.

The pilot project is a prototype for an Alberta province-wide public warning system that is being considered for future development. Such a system would utilize the ACCESS NETWORK CKUA-FM SCM facilities of its 15 FM transmitters located throughout the province.

ATTACHMENT "A"

EDMONTON REGION EMERGENCY PUBLIC WARNING (EPW) PILOT PROJECT

TRANSMISSION DEVELOPMENT PLAN


ORIGIN
CONTROL
RELAY ONE
RELAY TWO
RECEIVER ONE
RECEIVER TWO
MUNICIPALITIES
WEATHER OFFICE
RCMP
APSS
ALBERTA ENVIRONMENT
OTHER KEY AGENCIES
CKUA
IBM/AT Software
1 security
2 coverage
3 record
4 transmit
EPW TRANSMISSION
A tone
B voice
SATELLITE COMMUNICATIONS
SATELLITE LINK ESTABLISHED
TO TRANSMITTERS
DIRECT SATELLITE LINK TO SCHOOLS
CKUA AM/FM TRANSMITTER (SCMO)
RADIO
TV
CABLE
ALERT
PAGER
SCHOOLS
INSTITUTIONS
PUBLIC
EMERGENCY WORKERS
STUDENTS
CLIENTS

BUSINESS USE OF VIDEOTEX: THE ADDED VALUE OF THE NATIONAL INFRASTRUCTURE

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1. ABSTRACT

This paper explores organizational applications of videotex under different network infrastructure conditions. Two case studies are presented to help illustrate the ways in which videotex infrastructures can be successfully used for strategic purposes by organizations. An attempt is made to highlight the potential added value when a single, national videotex infrastructure with high penetration among the populace exists.

2. INTRODUCTION

Over the last twenty years, a wide variety of electronic text delivery systems have been developed in many countries. Collectively referred to today as videotex, these systems typically were first targeted towards mass consumer applications, primarily for information retrieval, limited forms of transactions, and communication services.(1) Discussions of videotex in both the popular press and the academic literature have exhibited a preoccupation with these consumer services, and relatively little emphasis on business applications. Despite the lack of attention to business use, and the highly publicized problems of consumer-oriented services in many countries, these systems have exhibited a gradual evolution toward business/professional services, and a number of organizations have effectively adapted videotex to serve critical business needs.(2) The user-friendly attributes of videotex can combine with the widespread access permitted by national network infrastructures to create an information utility that appears to be uniquely qualified to address certain organizational information dissemination and transactional needs. In this paper, we explore business applications of videotex using two case illustrations: one using the CompuServe system in the U.S., and the second using the French Minitel/Teletel system. Our objective is to first identify key classes of business applications of videotex. We then attempt to match classes of applications with their needs of certain types of connectivity provided by the videotex infrastructure. In this way, we hope to identify key ways in which a national infrastructure that connects a mass population of both businesses and home consumers permits the broadest range of strategic business applications.

3. BUSINESS APPLICATIONS OF VIDEOTEX

In this section, we examine how general features shared by all videotex systems interact with the type of connectivity they offer to foster specific types of applications.

3.1 GENERAL FEATURES OF VIDEOTEX

Definitions of videotex generally focus on two key factors that serve to differentiate it from traditional corporate information systems. First, videotex systems do not require specific expertise on the part of the end user; they are designed to be used by the general population without assuming familiarity with any specific technologies, applications software, or operating systems.(3) Thus, videotex systems present a common user interface that can integrate diverse data bases, making potential differences in format, command languages, and so forth transparent to end users. A second key construct is that videotex systems are designed to be used with low cost terminals, or can be accessed generally by any existing base of terminals or microcomputers.(4) The effective outcome of this type of design strategy is to increase the potential pool of users beyond those who traditionally access corporate information systems and data bases. Thus, videotex affords organizations with a technology that is appropriate for applications that are directed at large numbers of users who may lack technical sophistication.

In the United States, several highly publicized videotex ventures focusing strictly on the home consumer market have failed. Our case analysis uses the CompuServe Information Utility, which differs from the typical European videotex ventures in that it uses ASCII text rather than graphics, and requires a computer terminal or personal computer with modem as the terminal device, rather than attempting to use television receivers (as in the U.K. or Germany) or specially designed, low cost terminals (as in France). CompuServe has roughly 550,000 subscribers (as of late 1989). They market a business oriented service known as Interchange, which provides electronic mail, as well as the opportunity to provide access to private company databases and services stored on CompuServe mainframes and accessed over the CompuServe packet network.

Our second case is drawn from the Teletel system in France (more commonly known by the name of the special purpose terminal - Minitel). There are now more than 5 million Minitel users, resulting primarily from France Telecom's decision to give terminals for free to consumers. Most usage of the system is for electronic directory access, but there are more than 12,000 different information services provided by third party suppliers. Messaging services have received some attention in the popular literature, but professional services (i.e. business applications) are among the fastest growing types of uses.(5)

4. A FRAMEWORK FOR COMPARING APPLICATIONS

One approach to classifying applications of organizational videotex is to group them according to role the applications play in enhancing a firm's competitive position.(6) A typology based upon work by Keen (7) and by Porter and Millar (8) provides a useful framework for organizing competitive uses of information technology and is reproduced in Table 1.(9) In the first group of uses, organizations strategically apply information technology to enhance product differentiation and gain an edge in an existing market. For example, videotex systems that connect customers with suppliers in order to provide access to product information and lower the cost of transactions fit into this set of strategic applications. In the second group, applications are primarily designed to lower the costs of transforming inputs to outputs at varying points in the value chain by improving internal communications and information flows.(10) Systems that provide for electronic mail and data base access by employees are primarily directed at such internal efficiencies. Finally, the last group of applications refers to those situations where information technologies are used by firms to spawn new lines of business. These types of applications require broader connection to the customer base for the new product or service made possible by the videotex system.

TABLE 1

STRATEGIC TELECOMMUNICATIONS
APPLICATION FRAMEWORK

I. LOOK FOR AN EDGE IN EXISTING MARKETS

- Put a terminal in a customer's office
- Differentiate a standard product through service and information
- Improve customer access to the firm
- Improve the firm's knowledge of customer needs

II. RUN THE BUSINESS BETTER

- Manage distributed inventories
- Link field units to head office
- Improve internal communications
- Improve executive information

III. FIND SOURCES OF MARKET INNOVATION

- Make preemptive strikes
- Create new services by piggybacking and network interconnection

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Source: Adapted from Keen (11); reproduced from Steinfield et al.(12)

4.1 STRATEGIC APPLICATIONS OF IN-HOUSE SYSTEMS

Essentially, in-house systems provide excellent connectivity among employees, providing an electronic link to those in jobs not traditionally served by typical company information systems. Examples of classes of applications from the case study include information dissemination, electronic publishing, scheduling and coordination, and internal communications. Based upon the framework presented above, in-house systems are best thought of as a means to improve internal efficiencies. Organizations can gain competitive advantage by using videotex to reduce the costs of operations at various points in the product value chain. Obviously, such systems are less appropriate for product differentiation or market innovation efforts, as the network does not interconnect the customer population with the firm.

4.2 STRATEGIC APPLICATIONS ON INFORMATION UTILITIES

Systems such as CompuServe, which permit limited business-to-business connections given the relatively low penetration of its service, extend the range of applications to improve selected supplier to customer communication, information flow and transactions. As demonstrated by the now famous examples of the American Hospital Supply and Foremost McKesson companies, who extended their internal information systems by providing terminals and a telecommunications link out to their customer base, such applications clearly serve to differentiate a product from competitors' offerings.(13) In addition, many strategists have noted the advantage that being first gives to firms who connect their network to customers and suppliers. Both Keen (14) and Runge (15) refer to this as the advantage of occupancy, arguing that these customers and/or suppliers will be less willing to add other terminals and network interconnections from competing organizations. A key difference here, of course, is that the network, the application interface, and the computer storage are provided by an external vendor, which helps to limit capital investment requirements and the consequent risk involved. Thus, these videotex applications serve to strengthen customer-supplier relationships, and create barriers to competition from outside firms, even when a publicly available network is used. Moreover, improving the performance of a customer can have the added effect of creating additional demand, and subsequently, improved revenue for the supplier.

4.3 STRATEGIC APPLICATIONS ON NATIONAL VIDEOTEX SYSTEMS

Once a fully national public infrastructure such as the French Minitel system is available, however, the third class of competitive applications becomes increasingly more feasible. Market innovations are possible by piggybacking value added services on the network that generate new revenues. These new sources of business are more practical due to the large numbers of potential external links. Additionally, firms can launch preemptive strikes into new geographical areas, because of the reach of the network. Thus, firms like Company Three that serve as suppliers to large distributor networks now have a new telecommunications tool to seek out competitive advantage. The expert system that Company Three developed for diagnosing appliance problems is, in fact, a good example of piggybacking a new revenue producing service onto the existing network. At the same time, by integraing the parts ordering function into the expert system, they preempt any efforts by other service

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organizations to attract the repair person's business. Moreover, with a national videotex infrastructure, the external links to customers or suppliers can be forged without the need for an extensive private network.

5. CRITICAL MASS AND BUSINESS VIDEOTEX

An emerging theoretical perspective focuses on the need to achieve a critical mass of users before sustained usage of a telecommunications-based service can be expected.(16) Organizational videotex systems are no exception to this rule. Even for the in-house systems, the ability to reach a broad base of employees is necessary before most applications are justified. For example, publishing general employee information on videotex will pay greater dividends if the same information does not have to be distributed to people in hard copy form. In the case of another well known in-house videotex user, DEC, a key motivation for developing an in-house videotex system is to save on hard copy publication costs.(17) For product differentiation and market innovation, a critical mass of suppliers, customers, or other external entities is also required. The characteristics of videotex foster the potential formation of a critical mass, by providing the ability to interconnect through a simple interface. However, availability of terminals, and existence of an anchor application that draws users to the system, are other factors that contribute.(18) Although the forces that lead to the development of critical mass are not the focus here, the case analyses that follow do emphasize its critical importance in understanding how and why business videotex is used.

6.0 TWO CASE ILLUSTRATIONS

Two successful users of business videotex were identified from a variety of sources, including trade journal articles, contacts with videotex vendors, and contacts with videotex industry associations. The two organizations selected shared two principal characteristics:

1) Each organization was involved with the manufacturing, sales, and service of some physical product, rather than with the sales of information or communication services per se. Thus, we did not focus on information providers who might use videotex as a new distribution vehicle, but rather on organizations in a different line of business using the information technology for competitive advantage.

2) Each was relatively large and geographically dispersed

The key factor that differentiates the two cases is the particular network infrastructure upon which their videotex system was based. Essentially one could envision a continuum of connectivity, with the low end characterized by an entirely intracompany, private network, and the high end characterized by a fully interconnected national system linking large numbers of both businesses and consumers (as in the Minitel case). The middle range is a system directed at providing limited business-to-business interconnections, without full connection to a large consumer population (as in the CompuServe case).

6.1 CASE ONE - USING COMPUSERVE

Our first case is a subsidiary of a large, multinational industrial vehicle manufacturer, producing a line of industrial trucks. These vehicles are then distributed through an independent network of dealers throughout the United States and Canada. Marketing field representatives are based in regional offices throughout the country, and work with dealers to help support sales activities. In 1983, the company began investigating the use of electronic mail to help overcome difficulties they were having communicating with field representatives. The company began using an electronic mail service offered by CompuServe. They chose to use a service with an existing national packet switched network because the traveling patterns of the field representatives precluded use of the existing corporate private network. Field personnel were provided with portable terminals with built-in modems to call up and access their mail from any phone. In this fashion, marketing staff at headquarters could rapidly inform field representatives of pricing changes, product availabilities and the like, which could then be communicated to lift truck dealers.

An interesting development occurred once dealers saw their service representatives using the electronic mail service. They quickly requested that they be provided with a mailbox and terminal, so that they could more easily keep in contact with their field representatives. Field representatives provided their dealers with electronic mail and training, and before long, nearly two thirds of the seventy or so dealers had accounts on the system. Case One's marketing staff soon realized that they now had an electronic link to their immediate customer base, and began to develop applications to exploit this connection. They first discussed the development of potential applications with their company systems development people, but found that lead times were too long to be of use. At this time CompuServe began a strong push to offer private company databases on their host computers, which could then be accessed via the CompuServe packet switched network. They provided the means for the marketing staff to easily develop and prototype videotex applications.

With dealers now online, the videotex system is used as a means to provide product and sales-support information directly to dealers, in addition to electronic mail. Price information, shipping notices, and other product information were among the initial types of databases available on the system. Essentially, private company data is stored on CompuServe's computer and made accessible to dealers who are provided with a terminal and password. More recently, the system has been expanded to facilitate completion of transactions as well. Dealers can complete order entries over the system, saving time and reducing transaction processing errors. The system, for example, automatically recognizes valid options for each model of truck, and informs the dealer when they accidently request a truck with incorrect options. Other new services include allowing dealers to advertise the availability of used trucks and parts on the system, the provision of electronic forms for parts or price complaints, order change requests, notification of the availability of special rebuilt trucks and used or demonstration trucks from headquarters, and dissemination of general company news.

Case One represents our middle range network infrastructure, in which a public information utility with an international network but a relatively modest sized subscriber base, is used for both internal information exchange, and business-to-business connections. Company personnel feel that the system has been of great benefit, improving communications with field personnel and dealers while reducing telephone charges, and improving service to dealers. Operations have been made more efficient by reducing order entry time and virtually eliminating errors. In essence, the system emulates the functions served by Electronic Data Interchange (EDI) systems. Moreover, dealers themselves are better able to service the end customer - the buyer - by having immediate access to the most current price and product information, better knowledge of delivery schedules, and an enhanced ability to locate desired used products.

A brief survey of users was completed to identify the most frequent ways in which the service was used, as well as the perceived impacts of using the system. In addition, to highlight the importance of critical mass, usage rates were correlated with an index of the number of other relevant contacts who also used the system regularly. In general, users accessed the system approximately twice a day. A summary of key findings is provided in Tables 2 and 3.

TABLE 2

USES AND PERCEIVED IMPACTS OF USING VIDEOTEX IN CASE ONE

MOST FREQUENT USES

- get information on the location of a product or part
- get information on the price of a product or part
- get information on the delivery schedule of a product or part
- order a product or part
- send electronic mail

PERCEIVED IMPACTS

- more informed about what's happening in the company
- able to work at times outside the normal workday, particularly evenings and weekends
- make fewer errors when ordering products
- able to work more efficiently
- better able to stay in touch with people in other locations
- easier to disseminate information to other locations
- able to get product information more quickly

TABLE 3

CORRELATIONS OF PROPORTIONS OF RELEVANT CONTACTS ON SYSTEM WITH SYSTEM USES AND IMPACTS

	TOTAL NO. OF SYSTEM USERS
NO. EMAIL MSGS SENT PER WEEK	.31 *
COMMUNICATE WITH MORE PEOPLE AT WORK	.42 **
ABLE TO WORK MORE EFFICIENTLY	.30 *
STAY IN TOUCH MORE WITH PEOPLE IN OTHER LOCATIONS	.32 **
EASIER TO DISSEMINATE INFO	.34 **
EASIER TO FIND A PERSON THAT'S NEEDED	.27 *

* P<.05   ** P<.001

6.2 CASE TWO - MINITEL PROFESSIONAL USE

Case Two is a division of a large, multinational, electrical appliance and consumer electronics manufacturer. This particular division, based in France, provides after-sales service support to independent retailers and repair technicians who are licensed to sell and service their company's products. They also provide service support for a number of other vendors' products as well. Case Two thus provides after-sales support to approximately 10,000 separate retailers and independent repair people throughout France. After-sales support activities include technical training and assistance for repair persons, technical documentation on the equipment, and a full line of repair parts for service people.

Case Two began using videotex in 1982, using the French Teletel system. They initially worked closely with France Telecom in developing their application. Initially the 200 largest service sites were included in an online parts order entry trial, but once the French videotex system was expanded to provide access throughout the country, Case Two made their online order entry service available to all clients. Thousands of retailers and repair people then began to use their Minitel terminals to access the private, professional service offered by Case Two. The service was used primarily to order parts and supplies, and within two years, it had enabled the company to centralize their inventory and eliminate a series of regional parts distribution centers. Savings accrued both from the elimination of facilities as well as reduced inventory holdings. Moreover, turnaround time on parts orders was reduced from two weeks to two days, which enhanced product servicing, and subsequently the public's image of the product line. Thus, Case Two represents our high connectivity network infrastructure, where the videotex system is used because of the general public access to the system, enabling an immediate intercompany exchange of information to a large number of medium and small businesses throughout the nation.

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More recently, Case Two is experimenting with an extension of the Minitel service to include an expert-system based training application that would assist repair people in the diagnosis and repair of appliances and electronics products. They refer to this application as "just in time training," necessary because an increasingly differentiated product line has made it difficult to maintain repair persons' expertise with all products. This expert system correctly diagnoses appliance problems 80% of the time. Repair people are charged on the basis of connect time for use of this service. Moreover, as ISDN is rolled out in France, the company is working with France Telecom to help develop a system that will integrate an image database with this diagnosis service. This would enable repair people to actually see detailed pictures of the appliances they are repairing, and in conjunction with the expert system, be guided through the repair process. Moreover, the company plans to integrate the parts order function with this service as well. In addition, the expert system is being designed to automatically keep track of the types of repair problems experienced by their products. This information will be fed back to the design and manufacturing divisions of the company in order to help detect and correct potential structural flaws in their products. In the past, not only was it difficult to aggregate this type of product repair trend information, but without hard data, suggestions of potential design or manufacturing flaws were politically difficult to make.

A brief survey of users of Case Two's system is currently underway, but the data were not yet available at the time this manuscript was prepared.

7.0 CONCLUSION

Despite the limited success of consumer videotex in many countries, organizations may increasingly find it necessary to rely on their telecommunications infrastructure in ways that conform in spirit if not in name to videotex. Moreover, national videotex systems developing in Europe and elsewhere may provide a unique launching pad for innovative new services to constituents on an international basis. For example, a harbinger of future international organizational applications of videotex systems is found in the John Deere Company's use of diverse national videotex systems to create a telecommunications network linking European dealers in six countries.(19)

The case studies presented here help to illustrate how the particular videotex infrastructure helps to shape the applications that are possible. Each type of system architecture can be associated with particular classes of applications. In both cases, the videotex system provided access to a critical mass of specific users. However,the larger and more diverse scope of users on Minitel appeared to permit the development of strategic applications that extended beyond product differentiation and/or internal efficiency improvement applications evidenced in the first case illustration.

8.0 NOTES

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1. See for example, J. Tydeman, H. Lipinski, R. Adler, M. Nyhan, & L. Zwimpfer, *Teletext and Videotex in the United States*, New York, McGraw Hill, 1982; Dennis Sullivan & Michael Noll, 'A Bell System View of Videotex,' *Telecommunications Policy*, September, 1982, pp. 237-241; and Richard Vieth, 'Videotex and Teletext,' *Annual Review of Information Science and Technology*, vol. 18, 1983, for early views of videotex as a consumer service. The heavy attention paid to Minitel, with its initial emphasis on consumer-based services has further contributed to the perception of videotex as being primarily a consumer oriented technology.

2. Organizational applications of videotex are raised by Andrew Finn and Concetta Stewart, 'Videotex in the Office,' Communication Yearbook, vol. 9, Beverly Hills, CA, Sage, 1986, pp. 805-826; and Peter Keen, *Competing in Time*, Cambridge, Massachusetts, Ballinger Press, 1988. The migration of national videotex systems from consumer to business applications are described in Donald Case, 'Redefining Videotex' paper presented to the International Communication Association, Dublin, Ireland, June, 1990.

3. Tydeman et al, Op cit, Ref 1. Finn and Stewart, op cit, Ref 2.

4. Ibid.

5. Laurence Caby, Professional Uses of Minitel, presented to the International Communication Association, Dublin, Ireland, June, 1990.

6. See David Runge, ***Winning with Telecommunications***, Washington, D.C., ICIT Press, 1988, for a review of the literature on the strategic applications of information technologies.

7. Keen, op cit, Ref 2.

8. Michael Porter and Victor Millar, 'How Information Gives You Competitive Advantage,' *Harvard Business Review*, Vol. 63, No. 4, 1985, pp 149-160.

9. Charles Steinfield, Gary Pizante, and Megumi Komiya, 'Using Telecommunications for Competitive Advantage: A Case Study Analysis of Management Strategies,' *Information Age*, Vol. 12, No. 1, 1990, pp. 33-41.

10. See Porter and Millar, op cit, Ref. 8, for a discussion of information technology and the value chain.

11. Keen, op cit, Ref. 2.

12. Op cit, Ref. 8.

13. See Keen, op cit., Ref 2 and Runge, op cit., Ref 6 for a description of these two well known cases.

14. Keen, op cit., Ref. 2

15. Op cit., Ref. 6

16. See David Allen, 'New Telecommunications Services: Network Externalities and Critical Mass,' *Telecommunications Policy*, Vol. 12, No. 3, 1988, pp. 257-271; and M. Lynne Markus, 'Toward a "Critical Mass" Theory of Interactive Media,' in J. Fulk and C. Steinfield (eds.), *Organizations and Communication Technology*, Newbury Park, CA, Sage, 1990; for two theoretical statements of the role of critical mass in the diffusion and use of new telecommunications-based services.

17. The Digital Equipment Corporation estimates that they annually save millions of dollars by publishing various employee manuals in VAX VTX "Infobases" instead of distributing them in hardcopy form.

18. See Markus, op cit, Ref 16, for a fuller discussion of factors influencing the development of a critical mass.

19. Lee Dietrich, 'Multinational Videotex: John Deere European Dealer Network, Communique, December, 1990.

MIND INTERNATIONAL TELECOMMUNICATIONS SYSTEM

(MITSUBISHI ELECTRIC PRIVATE NETWORK)

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1. ABSTRACT

Because of Japan-US trade friction and EC integration, factories and R&D laboratories are advancing overseas and Mitsubishi Electric is becoming a global enterprise. It is obvious that the information and telecommunication systems that can provide appropriate information to any person any time and any place should become an extremely important issue of management for globalization.
On the other hand, due to the start of international digital leased line services, the development of digital telecommunication equipment and the relaxation of restrictions on telecommunications, international environments have changed or are changing rapidly. We have kept up with these demands and changes, that is, we have just completed the large scale private international network called MIND international telecommunications system.

MIND: Mitsubishi Electric Group Information Network by Digital Technology

2. NECESSITY FOR AND GOALS OF ESTABLISHING THE MIND INTERNATIONAL NETWORK

The most important issue for managing the globalization of companies is to realize a system on which any person can send or receive any type of data at any time from any place. The Japan-US trade friction forced Mitsubishi Electric to open a greater number of overseas factories and R&D laboratories, which in turn created a need for the MIND International Network. The existing analog lines for telephone, facsimile, and data were optimized by each media. This partial optimization has reached the limit for expansion of volume and capability of switching equipment. In 1985, Japanese telecommunications regulations were changed and new common carriers started high-speed digital leased-line services, thereby decreasing the cost of leased lines. Mitsubishi Electric developed our own digital telecommunications equipment to conform to the new regulations. We responded to these changes quickly and integrated our facsimile, telephone, data, and video conferencing system into a digital network. We carried out this domestic project from 1986 to 1989. MIND International Network was developed based on the same digital network concepts, techniques, and equipment used in our domestic network. Our goals for the international project are as follows:

- Establish an infrastructure for global management
- Cut and control telecommunications costs
- Create a system model which reflects the progress of the international telecommunications business

2.1 ESTABLISHING AN INFRASTRUCTURE FOR GLOBAL MANAGEMENT

1) GLOBAL INTEGRATED TELECOMMUNICATION NETWORK

Due to the relaxation of international electronic communications regulations, Mitsubishi Electric is now able to allow its affiliates to share its leased lines. As a result, we are able to design the network more efficiently, communicate over a wider area and construct an international network which operates in the same manner and provides the same services - facsimile, telephone, and data - as our domestic network.

2) SHARED INFORMATION

Another important management issue for multinational companies is Corporate Identity, which requires the sharing of standardized, strategic information. Use of the infrastructure to support such shared information is becoming increasingly important. For example, international finance systems, international procurement systems, semiconductor strategic marketing systems, and service parts supply systems are now in operation as international common systems. These global information systems must be increased to cover all of our business activities. When this is accomplished, all of the members in the Mitsubishi Electric group can share the total resources of the network under any circumstances.

3) TO ESTABLISH REGIONAL MANAGEMENT

In order to deal with the trade restrictions imposed by the 1992 EC unification, Mitsubishi Electric will begin to conduct the total management process overseas, from the design of new equipment through its manufacture to marketing of the finished product. We therefore need a regional network to support these operations and to link to our global network efficiently. The flow of data, which now radiates outward from Japan, must be shaped into a matrix which provides anywhere to anywhere communication.

2.2 CUT AND CONTROL COSTS

When we began planning the MIND network three years ago, we expected to cut expenses by 30 - 40% as a result of installation. However, due to the tariff cut by international carriers, including KDD, the actual percentage is lower than expected. On the other hand, the volume of TCP/IP-dependent CAE/CAD is greater than our expectations, and relaxation of telecommunications regulations have progressed, allowing us to expand our services. As a result, we can expect increased savings in the future.

2.3 SYSTEM MODEL WHICH REFLECTS THE PROGRESS OF INTERNATIONAL TELECOMMUNICATIONS BUSINESS

In order to comply with customers' requests to provide proof that our telecommunications system is based on cutting-edge technology, we are first developing an international telecommunications model for our own company. (FIGURE 1.)

3. OUTLINE OF OUR NETWORK AND SERVICES

3.1 BASIC CONCEPTS OF THE NETWORK

It is natural in terms of our trade activities that communication traffic tends to concentrate on four specific areas, namely North America, Europe, Southeast Asia, and Japan. North America and Europe practice bloc trade within their respective areas. On the other hand, our Southeast Asian affiliates interact with overseas sales offices and factories rather than conducting bloc trade. The MIND international network was designed to accommodate the different characteristics of these four areas.

Telecommunications regulations also differ in each country. The relaxation of regulations has accelerated, especially in Japan and the UK. For example, links between private and public lines are now allowed conditionally in Japan and the UK. At the time we started the project, such links were available only in the US. We specifically designed the network with links to the PSTN in mind.

We installed a back-up route through the PSTN to provide for malfunction or overload of the international leased lines. We are planning to change the back-up route from PSTN to ISDN.

The link between Regional Communication Centers (RCC) and major offices is on analog circuits, while the link to minor offices is via PSTN or Public Switched Data Network (PSDN). The PSTN and PSDN link enables the network to expand and cope with traffic flows flexibly.

3.2 SERVICE AREA OF THE MIND NETWORK

The MIND network covers 10 countries - the US, Canada, the UK, Germany, France, Italy, Hong Kong, Singapore, and Japan.
The network provides services to 45 overseas affiliates and 81 offices in Japan. (FIGURE 2.)

4. FEATURES OF THE SYSTEM

4.1 TELEPHONE SYSTEM

All sites are able to dial each other directly with a unified dialling operation; "Office code plus Extension number."
Dialling directly to extensions not only shortens a call by 30 to 60 seconds, but also cuts telephone expenses by 15%.
We give office codes to sites which are not connected by leased line wherever the telecommunication regulations allow the connection. Tandem switches (TS) translate office codes into PSTN numbers automatically. Leased line - PSTN connection is allowed in the USA, Hong Kong, and Singapore. We installed Direct Inward System Access (DISA) facilities at tandem switches in these countries, so an employee staying at a hotel on a business trip or residence can access the system. We are planning to install DISA facilities in Japan when telecommunication regulations allow the connection.
A high voice compression equipment (APC-MLQ:Adaptive Predictive Coding - Maximum Likelihood Quantizer) developed by Mitsubishi Electric, was applied to digital voice transmission over the international telephone system. This technique compresses digital voice to 9600 b/s, less than one sixth of PCM, although the voice quality is considered good enough for an international private network.
Propagation delay over long circuits is inevitable when using international telephone systems. We install marine cable wherever possible to reduce propagation delay, which affects user feeling more than any other factor.

4.2 FACSIMILE MAIL SYSTEM

A store and forwarding system based on Massage Handling System (MHS) was adopted for group 3 facsimile communications.
A facsimile terminal calls the closest Facsimile Mail Processor (FMP) over the telephone system and sends the facsimile. The FMP transfers the facsimile on data link to the FMP which is closest to the destination terminal. This FMP calls the destination terminal through the telephone network and delivers the facsimile.
Although PCM is required in order to transmit the modulated signal of group 3 facsimiles, FMP transmits over a 9600 b/s data link. And a winchester disk in the FMP can moderate peak facsimile traffic at both ends of the international link. Those two factors reduce the required capacity of the international leased line.
All facsimile terminals which are linked to our system have a four digit abbreviated number in their Transmitting Subscriber Identification (TSI) fields. An FMP recognizes the sender's TSI, so the user is only required to dial the destination number. If a destination terminal in a different time zone is powered off during the night, the FMP stores the facsimile and delivers it when the destination country begins work the next morning.

4.3 LEASED LINE / PSTN CONNECTION AND SECURITY

The system has a PSTN interface on telephone and facsimile communication wherever the telecommunication regulations allow the connection.
For telephone calls, it is necessary to enter a password to access our system. A Tandem switch prompts the caller to enter the password. After the password has been approved, the caller can access the system as if he were calling from a MIND extension.
For facsimile, the FMP identifies the calling terminal's TSI. If the TSI of the calling terminal is not registered in the system in advance, the FMP will disconnect the call. This automatic TSI recognition is important for security, traffic statistics, and "Transmission Failure Notices" which are returned to the sender when the FMP cannot deliver facsimile.

4.4 RE-ROUTING THROUGH PSTN

We installed a re-routing function over the PSTN. This improves a line capacity of the system and provides alternative routes when an international circuit has failed.
An international circuit is the least reliable part in the system, so providing an alternative route is the key to improving system reliability.

ISDNs between Time Division Multiplexors (TDM) will become one of the most efficient and functional re-routing methods in the future.

4.5 CONCENTRATED MONITORING AND DIAGNOSTICS

Time and language differences can be serious problems when the system has failed. Concentrated monitoring and diagnostics functions are essential for an international system.
The Network Control Center (NCC) at Tokyo monitors the system 24 hours a day. When the NCC detects a failure, it shows the location of the failure on the monitoring screen and issues a trouble ticket. Tickets are logged for statistical analysis.
The system has a single control center in Tokyo at present, but multiple control centers are required to enable monitoring and controlling from each RCC. (FIGURE 3.)

5. ISSUES OF INTERNATIONAL NETWORK CONSTRUCTION

5.1 PROBLEMS WHICH HAVE TO BE OVERCOME

1) DIFFERENT COMMUNICATIONS INFRASTRUCTURE AND REGULATIONS

As a whole, regulations have been relaxed recently in many countries, and we are beginning to receive the same level of services from carriers and vendors.
Therefore it is important to take advantage of those changes to improve the efficiency and the service of our network.
We designed the system using techniques developed in the US which are the most appropriate communications systems to meet the deregulation at this moment.

2) TIME DIFFERENCE

To reduce inefficiency in use of leased lines due to time difference, it is essential to introduce new techniques like voice and image compression for telephones, facsimiles, and video conferencing systems.
As far as load distribution techniques are concerned, the store & forward system is regarded as the most efficient for facsimile, telex, and data transmission. However, demands for real-time transmission are still increasing. To cope with those demands, other methods of facsimile transfer using APC-MLQ, or Data Speech Interpolation (DSI) are under consideration. We are planning to introduce the DSI which we produce and has already been installed on another system.

3) APPROVALS AND MULTI-VENDOR/MULTI-CARRIER ENVIRONMENT

To obtain the greatest efficiency in monitoring and controlling the whole network, it is essential to install the same model of equipment. For this reason, we adopted our TDM and FMP which already had approvals from the authorities of major countries. However, since it is almost impossible to get full approvals, we adopted multi-vendor supply in our system. As a result, the system became rather complex in terms of functions and operations.

5.2 REQUESTS TO CARRIERS

1) MORE RELIABLE LEASED CIRCUITS

The quality of the international leased circuits are only one tenth to one twentieth as good as Japanese domestic ones. Most troubles with current operations have been happening on the international circuits. Twenty-four hour service (for both international and domestic circuits) is required.

2) QUICKER CIRCUIT INSTALLATION

It normally takes 3 to 10 months to have an international circuit installed from end to end. Sometimes we cannot get a scheduled date for the installation unless we submit an official application.

3) PRICE REDUCTION OF LEASED CIRCUITS

Compared with the reduction in public tariffs, the scale of reduction in leased line prices is small and infrequent.
In addition, they charge separately for the domestic part of an international leased circuit, which is relatively expensive. We would like the domestic and international parts to be defined as a single system resulting in the same tariffs, or more domestic access points to international links to be established.

4) MAINTENANCE SERVICE FOR SYSTEM CONTROL PARAMETERS

Carriers or vendors usually take care of the maintenance of system parameters in TSs and PBXs. Different vendors have different maintenance routines. Our system parameters need to be modified frequently, for example, every time office renovation or moving or password change occurs. It normally requires 2 to 4 weeks to have a system control parameter changed.

6. FUTURE EXPANSION

As a first phase, we have just completed the installation of major digital trunk lines. We have been not only expanding but also diversifying globalization of our business activities. In addition, carriers have been improving their services steadily. In accordance with these trends, we will be improving and expanding the existing MIND network. The following is our plan for expansion and improvement of MIND services.

6.1 EXPANSION

One of the essential elements of a communication network is to provide common services and a basic level of management information for any site on the network. Because our aim is to cover all of our overseas offices, we plan to combine a new carrier service or another VAN service with the current system.

6.2 NEW MEDIA AND CARRIER SERVICES

There have been increasing demands for video conference and group 4 facsimile facilities. Twenty-six video conference systems are currently in operation on the MIND domestic network, while international tests between Japan and the UK are currently underway. In order to increase the efficiency of video conference equipment, we plan to offer the option of using ISDN as well as our own network.

6.3 HIGH SPEED LAN CONNECTION FOR ENGINEERING

Because our R&D labs are moving overseas, demands for high speed LAN connections for engineering tasks such as development and analysis are increasing. Therefore, we plan to establish LAN networks which, to increase efficiency, will utilize both the MIND network and ISDN.

6.4 INTRODUCTION OF EDI AND MHS SERVICES

An Electronic Data Interchange (EDI) system and an electronic mail system have already been introduced into regional networks in Japan, the US, and Europe. The same services are required for international communications. We are planning to integrate an internationally standardized system, based on the MHS model, into the existing international network.

6.5 ON-LINE DIRECTORY FOR TELEPHONE AND FACSIMILE

It requires a lot of time to keep telephone and facsimile directories updated, especially within a multinational corporation. In order to increase efficiency, we have already introduced an on-line directory system into domestic use, and are planning to modify it for international use as well.

6.6 MODIFICATION AND ENHANCEMENT OF THE RCCs

The RCCs are to be revised for fully automatic operation. They will be monitored from Japan, but will be responsible for diverse jobs from improvement and modification planning to trouble-shooting, specifically including use promotion, user-support, correspondence in case of emergency, and maintenance. Therefore, it is important to hire and train staff regularly or to hold meetings with delegates from each RCC at regular intervals in order to cooperate more closely with them as members of the MIND project.

7. CONCLUSION

We attribute the establishment of the MIND program in the relatively short time of three years to great cooperation from our overseas sites and technical knowhow from sites which participated in the construction of the domestic network. We also attribute MIND's establishment to the widely accepted concept of how important the communication infrastructure is for a multi-national corporation. We shall keep trying to improve the system and train staff members based on the technical and operational knowledge obtained through this construction in order to keep up with diversifying users' needs and environmental change produced by technical advancement. We appreciate the continued cooperation of our carriers and vendors.

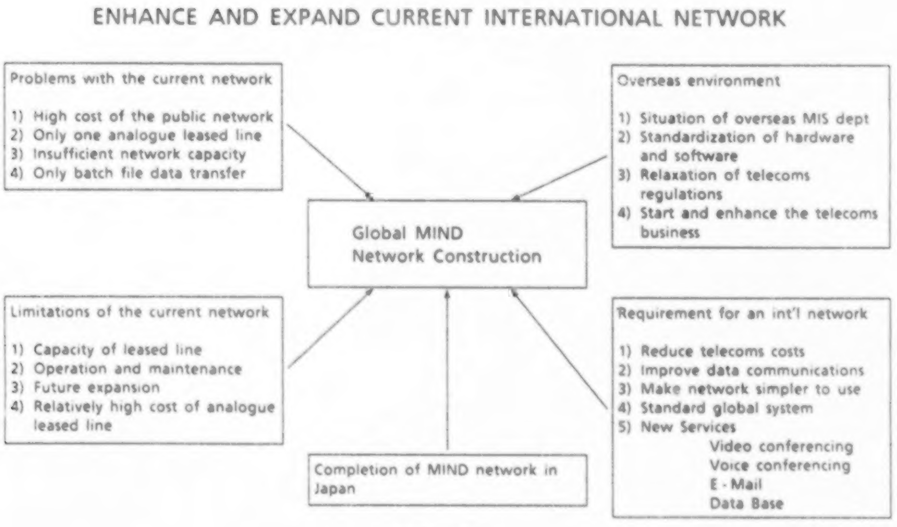
ENHANCE AND EXPAND CURRENT INTERNATIONAL NETWORK
Problems with the current network
1) High cost of the public network
2) Only one analogue leased line
3) Insufficient network capacity
4) Only batch file data transfer
Overseas environment
1) Situation of overseas MIS dept
2) Standardization of hardware and software
3) Relaxation of telecoms regulations
4) Start and enhance the telecoms business
Global MIND Network Construction
Limitations of the current network
1) Capacity of leased line
2) Operation and maintenance
3) Future expansion
4) Relatively high cost of analogue leased line
Requirement for an int'l network
1) Reduce telecoms costs
2) Improve data communications
3) Make network simpler to use
4) Standard global system
5) New Services
Video conferencing
Voice conferencing
E-Mail
Data Base
Completion of MIND network in Japan

FIGURE 1.

MIND INTERNATIONAL NETWORK

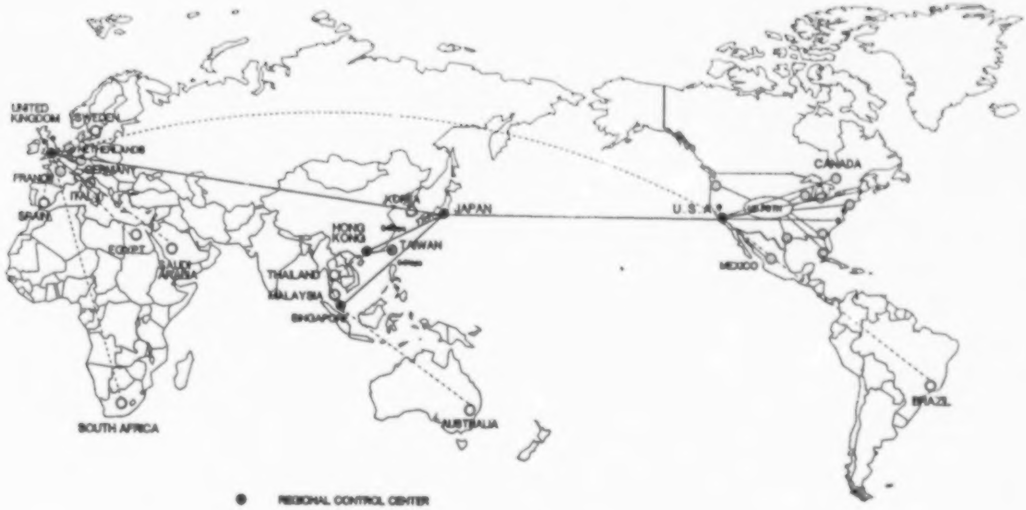
UNITED KINGDOM
SWEDEN
NETHERLANDS
GERMANY
FRANCE
ITALY
SPAIN
EGYPT
SAUDI ARABIA
SOUTH AFRICA
KOREA
JAPAN
HONG KONG
TAIWAN
THAILAND
MALAYSIA
SINGAPORE
AUSTRALIA
U.S.A.
CANADA
MEXICO
BRAZIL
● REGIONAL CONTROL CENTER
◉ TEL. & FACSIMILE COMMUNICATION
○···· PLANNING

FIGURE 2.

MIND International Architecture

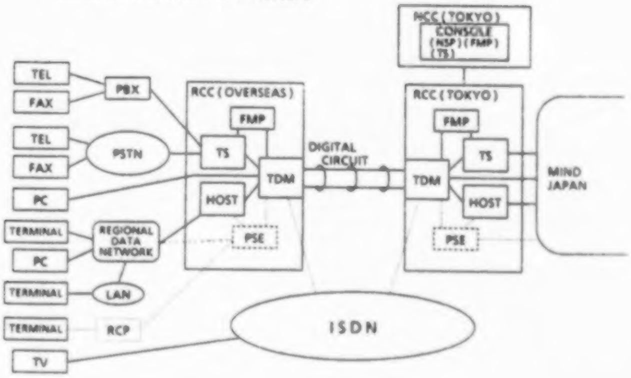
NCC (TOKYO)
CONSOLE
(NSP) (FMP)
(TS)
TEL
FAX
PBX
TEL
FAX
PSTN
PC
TERMINAL
PC
REGIONAL DATA NETWORK
TERMINAL
LAN
TERMINAL
RCP
TV
RCC (OVERSEAS)
FMP
TS
TDM
HOST
PSE
DIGITAL CIRCUIT
RCC (TOKYO)
FMP
TS
TDM
HOST
PSE
MIND JAPAN
ISDN

FIGURE 3.

Hail The Rapid Growth of Pacific Telecom

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ABSTRACT

This is a briefing of CITIC activities in telecommunications and the affiliated technology .Her efforts in this field have won public attention in China and Hong Kong . The big opportunities in the Pacific region would be well correlated with high-tech . The sooner this region adopts more intensive high-tech, the further it would grow.

People would like to ask or estimate how fast will Pacific Era grow: In a time span of half century or only a few years to turn around?

There are big opportunities in the Pacific hemisphere though the participant countries are quite different in the development of their economy ,their per capital income ,and their policies . But the industrialization of this region come so rapid and booming . Her trade volume has already surpassed Atlantic.

Some strong buyers from the East have made a wide network of business connections. For instance a media source reported Japan has invested more than 400 billion outside the country. The media also reported the emigrant tide of Hong Kong . Nevertheless, business is business. From 1970's, that is since the open policy of China started, Hong Kong got better and till 80's ,got more. At the same time ,its land price ,wages and staff turnover rates are rising enormously, and as well in Taiwan or in Japan . Therefore, the outfolw of investment is a response rather to the unfavorable development in the investment climate.

The cure is how to alien their goals, to promote mutual understanding s, seeking new opportunities or the conjugate points of technology , manpower and finance,ect.1990's are the years of rapid growth of hi-tech . We can surely forecast the quicker growth in compare of 80's.

China is a developing country ,an old nation, but pending the reform and wins the world attention to its open door policy.

To my knowledge , Hong Kong is going to be a more important region as industrial and trade volume grow rapidly . Since the open up policy of China started in 1978, the 11 years average of trade of transit goods increase is 35% per year, and average local products export increase by 17% per year. Therefore , the trade increase is closely tied to mainland. From 1978, the first year of China 's open up, to 1988,the trade volume of Hong Kong with mainland increased 26 times. In which , the structure of import and export changed quite a bit. Hong Kong's exportation of electronic and electric appliances to mainland hadshown a jump. At the same time , many joint ventures have been built up in mainland with Hong Kong electronic manufactures participation. Some parts of their production activities are settled down in the mainland cities and managerial , financial and sales used to be centered in Hong Kong. This strong correlation is a trend of development formed naturally due to the cost and profit concerns and also to the work forces. It would speed up the new product developments and new market development. The more direct contacts of China trade internationally might result the less transit trade depending to Hong Kong. The forthcoming age for Hong Kong's economy would be a fortune if measures of developing new products and new markets were both taken into serious consideration. The momentum of combining the prevalence of both the mainland and Hong Kong to meet changing market demands will certainly drive the trade volume to a much higher level.

Telecommunications and transportations are two major carriers of speeding up the refining of investment climate. Gathering information through computer networks is one of the most distinguished successes of hi-tech field in this century which enlarge the wealth of mankind . When individual or private information networks are joined toghther by public networks, a brand new scenerio arisen . The users would be unexpectedly tossed off the common trade to a very convivial and easy going level. Every step of it, to explore ,study, exchange and upgrade it , is a donation to the whole world.

China International Trust and Investment Corporation is mainly a financial and investment enterprises. Could we fill a better role in the ploy of the said growth of this region?

While some 3rd world countries are driving their attention to those high return projects, we choose our own way of approach . Bearing in mind, our investment must be beneficial to the society , must be profitable and must be affordable by our ability , we started our business in electronics field in the following ways:

1. Invest in Chinese electronic industries of high-tech, such as special radio components, digital telephone exchange, word processor development , marine electronic equipments, laser application , industrial measuring devices, ect.

2. Invest in some good shaped telephone

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companies, such as Hong Kong Telecom and Macau Telecom . With 20% share each , the Hong Kong Telecom stake , cost about HK$ 1.8 billion where in Hong Kong , the IDD calls per capita is the highest in the world.

3. Finance and invest in the Satellite system Asia-Sat.I. This satellite was made by Hughes of U.S., owned by CITIC, British Cable and Wireless and Hong Kong Huchinson and launched by a Chinese rocket on April 7, 1990. It was a cooperation fruit of China open door policy , and to be used by some 30 countries from Asia to the Mediterranean.

4. Help developing the communication systems made in China for exportation . Myanmar had her first ground stations network open to public use at the end of May 1990 through Asia-Sat I. The chinese made small parabola antennas for home TV receiving of satellite signal are produced with very high standard and very competitive cost.

5. Set up specialized network inside China for the use of banking and industrial purpose by utilizing one transponder of Asia-Sat I.

6. Building CITIC's information center and computer network linked with our own and world known information sources , such as Reuter Monitor, Financial Broadcast Service, U.S. Dialogue System , Chinese Information System, U.S.DRI System ect.

7. Train our own software team , and speed up the cooperation with foreign software groups. Our aim is to shorten the distance between the technical personnel and our business staffs, and make better use of our computer system. Yes, we spent a lot in our system, and are not satisfied with the result.

CITIC created her new investment strategy in electronics sector with a massive effort to develop high technology products which help pave a period of rapid and climatic changes that will finally alter the nature of telecommunication infrastructure of China , and also we hope , that of Asia .

Hong Kong , Japan, EEC, U.S., Asian Nations and the Soviet Union, in that order , are the six major trading partners of China in terms of bilateral trade value . Export of manufactured goods paid off by technology have been growing, while those of raw materials has slowed down .

The updating of production, the renewal of equipments , the practical usage of resources and development of new products are all closely tied to hi-tech .

The international market is extremely competitive. CITIC gradually expands her assets overseas, more revenues resulted and more chances created . We had also boosted our exportation to generate more hard currency. Notwithstanding, we met more challenges in technical field.

China had rapidly developed her own hi-tech, for instance, in nuclear energy, electronic equipments, space technology, bio-engineering ect. A very important further step is to transfer it into productivity , and by no means, CITIC would not like to fill a gap in between , though our team have to catch up the race.

The competitiveness of our business is also well correlated to acquire of new technology , including the training of our team to make use of information to solve their business problems with computers. The barriers to the adoption of advanced technology in a firm like is the shortcoming of our people have not get use of a technical hand rather than stick to their familiarized experiences. This phenomenon might , of course , not be an unique one aroused in our company, as I simply think it's everywhere in the business organizations in the world .Therefore there is still a long way to ride but technology development will stop, which would certainly trigger the next coming industrial revolution and the Pacific Era will certainly play a big role in it. The sooner the Pacific region adopts more intensive hi-tech, the faster it whirls the final goal.

Wednesday, January 16, 1991

Closing Session

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